THE

ELECTRICAL REVIEW.

VOL. LI. JULY 18, 1902. No. 1,286.

"ELECTRICAL REVIEW."

Vol. LI.] CONTENTS: July 18th, 1902. [No. 1,286.

	Page
Provisional Orders—1902	89
The Electric Tramways Exhibition (*illustrated*) (*continued*)	91
The Report of the Commission on Water-Tube Boilers	96
The Growth of Fuel	97
The Castelli Receiver for Wireless Telephony (*illustrated*)	98
Correspondence:—	
Patent Law Reform	99
Legal	99
Parliamentary	101
Business Notes	101
The Electric Tramway System of Newcastle-on-Tyne (*illus.*)	107
Electrical Plant at the Düsseldorf Exhibition (*illustrated*) (*continued*)	108
Electric Power Transmission in New Zealand (*illustrated*) (*concluded*)	111
City Notes	116
Traffic Receipts	118
Stocks and Shares	118
Share List of Electrical Companies	119
Market Quotations	120
The Municipal Electrical Association—1902 Convention	121
Earthing Problems (*illustrated*)	123
Two *v.* Three-Wire Distribution	123
The International Tramways Union Congress, 1902 (*continued*)	124
E.E.R.E.(V.) at Portsmouth	125
The Progress of Electric Space Telegraphy (*concluded*)	126
New Patents	127
Abstracts of Published Specifications	128

THE

UNIVERSAL ELECTRICAL DIRECTORY

1902 Edition

READY.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

CAN BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEKRAY, LONDON." Code, A B C.

Telephone No. 983 Holbot

All Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades,

AND HAS

BY FAR THE LARGEST CIRCULATION

of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—In Great Britain, Post Free per Year, 19s. 6d. To all other countries, per Year, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can now be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. Paris: VEUVE J. BOYVEAU, 22, Rue de la Banque. Berlin: ASHER & Co., 13 Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to H. ALABASTER, 4, Ludgate Hill, E.C.

PROVISIONAL ORDERS, 1902.

THE Board of Trade have issued the usual return, for the current year, of applications for provisional orders submitted to Parliament in the present session.

There are several points of especial interest in the decisions of the powers that be, that establish new precedents for the future. The number of applications shows a considerable falling off from last year, when 98 provisional orders were granted, against 64 only in the present session.

Local authorities applied for 45 orders, of which 41 were granted, and the reasons for the refusal of the four applications thrown out are significant. Private companies applied for 22 orders, every one being granted; in one case, where it was desired to incorporate two districts in one order, the Board of Trade objected, and, in consequence, two orders were granted, making 23 in all. Local authorities attempted to obtain competing powers in the cases of Pokesdown (Bournemouth), Chiswick, St. Olave, and Southwark, but they did not succeed in either case, the applications being opposed by companies authorised to supply the respective districts.

In another case (that of the Corporation of Camberwell) the Board of Trade imposed conditions with respect to companies in possession, which the local authority objected to, and therefore abandoned their application.

The Electric Lighting Act, 1888, disposed of all question of a monopoly in the supply of electricity, the terms of the Act being unequivocal on the subject. The clause reads as follows:—

"The grant of authority to any undertakers to supply electricity within any area, whether granted by license or by means of a provisional order, shall not in any way hinder or restrict the granting of a license or provisional order to the local authority or to any company or person within the same area."

No doubt the circumstances of each case rendered it, in the interests of the several localities, advisable to protect the companies from municipal competition; but it must not be overlooked that in principle no monopoly in the supply of electricity has legislative sanction.

Competition has been allowed in several cases, especially within the metropolitan area, where it was considered desirable to give consumers the opportunity of obtaining a supply under either the alternating or continuous current systems; under the altered circumstances of the present day when long distance transmission and the supply in bulk are likely to supersede the old methods, it will be impossible to prevent competition between the great power distributors and those who adopt small local generating stations.

Parliament does not do things in a hurry, and the political influence of local authorities is at all times a powerful brake upon its speed, but sooner or later improvements must be recognised, and the best systems prevail.

The important developments in the generation and dis-

tribution of electricity account, no doubt, for the falling off in the number of applications for provisional orders for isolated towns, and we may expect that in the near future the great power companies will be the principal applicants for powers to distribute, as well as to supply electric energy in bulk.

There are probably other reasons which immediately affect the number of applications for powers, apart from the consideration of the future comprehensive method of supply. Local authorities are perhaps pausing in their eagerness to trade in a business which experience proves to be not quite so profitable to the ratepayers as they supposed. The difficulties in building up a business involving a change of habits and considerable expense to the consumers, are becoming more apparent as the annual results are analysed. The local authority feels all this more keenly than the expert company, for it is hampered in many ways in having to borrow and repay the necessary capital, restricted in such matters as the wiring and fitting of consumers' premises upon hiring terms, and unfitted for pushing a business it does not understand. Ratepayers are getting shy of the speculation at their risk, and are becoming more pronounced in their opposition to the raising of loans for such purposes.

The annual accounts of the Electric Lighting Committees, when investigated by competent and independent experts, warrant the suspicion of the ratepayers that little reduction in their burdens will come from trading in electricity, and some of the Councils are transferring their provisional orders to private companies competent to organise and carry on the business properly. In the present return of the Board of Trade transfers of provisional orders from local authorities to companies are notified in the cases of Airdrie, Ambleside, Birkdale and Ilfracombe, and others are agreed upon including St. Albans, Aylesbury, Chichester, &c., whereas there is no instance of a transfer from a company to a local authority. The Denton order taken in 1897 by the Urban District Council has been transferred to the Manchester Corporation.

The case of Pokesdown, already referred to, has a further interest, inasmuch as it was granted to a company, although the consent of the local authority was refused, the Board of Trade exercising their right to dispense with such consent under the circumstances of the case.

The application of the Bermondsey Corporation for an extension of their powers to their new area of Rotherhithe, is of especial importance, because the opposition of a gas company in their capacity of ratepayers resulted in Parliament imposing a practically unworkable condition, viz., that the price charged to the consumer should be such as to prevent loss to the ratepayers. This places the local authority on the horns of a dilemma, for if they charge too high, they will not get customers, and unless they do, they cannot cover working cost, interest, sinking fund, and depreciation. This is a severe blow to municipal trading in electricity, for if the gas, railway, and other large ratepayers combine against the grant of provisional orders to local authorities, they will no longer be granted.

The interesting case of the Rhondda Valley Tramway Bill is important in its bearing upon the question of the check it gives to reckless borrowing by local authorities for speculative purposes.

The Committee did not think that the Council should expend £290,000 in constructing tramways which might not pay, but approved the preamble of the Bill, subject to the ratepayers being protected from loss, by the grant of a lease for 42 years to a company upon such terms as would be adequate for providing the requisite appropriations, sinking fund, &c., the company being compensated on the termination of their lease on the terms prescribed in Section 43 of the Tramways Act, 1870.

The close of the South African War appears to have stimulated municipal borrowing, the loans for the six months ending June 30th last being £3,767,269 in excess of the amount raised in the corresponding half-year of 1901. The rates of interest have varied considerably, 3 per cent. stock being issued at 90 in the case of Taunton, up to 99 for a loan to the Corporation of London.

Local authorities have to pay much higher rates of interest now than was the case a few years ago, when loans were obtained by a small borough at 105½.

The efforts that are being made to render borrowing by local authorities easier, by extending the period for repayment, and especially in suspending the sinking fund during the first two or three years, would, if successful, have a dangerous tendency in removing the checks upon reckless trading and giving to the accounts for the time being a deceptive character.

The Castelli Receiver.

On another page we publish some notes by Mr. Sullivan upon the Castelli tube, or new microphonic receiver, for wireless telephony. This instrument is a radical departure, which seems likely to have far-reaching results in aerology. Curiously enough, but for a recent controversy in a lay journal, we might not have heard for some time to come of the new apparatus and the important results obtained with it, although the admission of Messrs. Marconi & Co. that in their fascinating trans-Atlantic experiment of last winter they had employed a *telephone* as the receiving instrument in Newfoundland first excited inquiry as to the particular type of receiver with which the telephone was joined up, when the now historic S'S'S. . . . in the Morse code alphabet were transmitted from Cornwall, whether through the medium of the æther or the earth. As regards the susceptibility to atmospheric disturbances of the present filings coherers, the paper read by Captain H. B. Jackson, R.N., F.R.S., before the Royal Society in May last, and now just published, "On Some Phenomena affecting the Transmission of Electric Waves over the Surface of the Sea and Earth," throws waves *of light* upon the serious interference with signalling which is experienced from this cause, even in the Mediterranean. Captain Jackson's paper, which teems with practical information and suggestive ideas, is the more valuable because he was the earliest naval officer and independent worker in what is now termed wireless telegraphy. It must be satisfactory to know that as our own navy was the first to independently and officially recognise the advantages on warships of wireless signalling, so since then has it maintained its lead in this new field. We must heartily congratulate the Italian navy and Semaphorist Castelli upon the practical success of his brilliant and original idea. Speaking of the Castelli invention, the *Pall Mall Gazette* of the 10th inst. says:—"One interesting feature of the case is that this beautifully sensitive instrument is unpatented, and can be employed by anyone who chooses to rival Signor Marconi in his efforts to annihilate space."

THE ELECTRIC TRAMWAYS EXHIBITION.

(*Continued from page 52.*)

Messrs. Ferranti, Limited, of Hollinwood, had a capital exhibit of their switchgear manufactures. The two main exhibits were(1) the Ferranti patent H.T. sub-station board, (2) the

Ferranti L.T. Switchboard for Long Eaton.

patent L.T. continuous current board. The H.T. sub-station board is for use on a three-phase system, provision being made for controlling two in-coming feeders, and the primaries of three stationary

Ferranti H.T. Switchboard for Dublin.

transformers, connected delta fashion, at the sub-station. A panel is provided for a fourth transformer, which can be used as a substitute for any of the other three, in case any one of them should break down. This board comprises a very compact and easily operated gear, and safety as regards danger of shock is a special feature, all live parts being placed at the back of the cells, and out of reach of the attendant. Great care has been taken to provide a separate cell or compartment for each phase, so that short circuiting between the phases is impossible. Nineteen similar boards are at present on order for the Dublin Corporation. Three generator panels, forming a section of a L.T. continuous current switchboard are shown. One pole of the machine is provided with a combination switch, which can be operated either as a hand release switch or by an automatic attachment placed in the panel below. The other pole of the machine is provided with a knife or paralleling switch, a paralleling contact being provided in the panel. The above panels have been designed to be operated as follows:—When it is required to put a machine on to the bus bars, the automatic switch is first closed; the machine is then run up to voltage, the knife or paralleling switch being placed on the paralleling contact. When the machine is at the same voltage as the bars, this switch is finally closed. Should there then be any fault

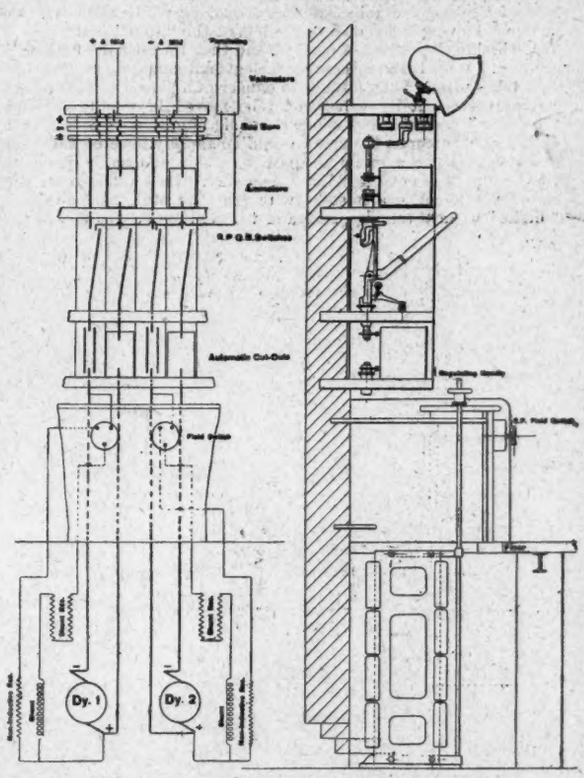


Diagram of Connections and Cross-Section of Switchboard for Long Eaton.

in the circuit, the automatic switch at once opens. It will be seen that with the above arrangement no plugging devices are required, and that the possibility of the switchboard attendant making mistakes is reduced to a minimum. The machine ammeter is placed above the switches. A fuse may also be used if required, and placed below the knife switch. The bus bar voltmeter and paralleling voltmeter will be seen on the top of the board, within easy view of the attendant. Among the other exhibits on the stand were two rheostats of the Ferranti open type, in which the regulating switch and rheostats are combined in one apparatus. No bunching of connections whatever is necessary with a rheostat of this type.

Various types of oil break fuses were also in evidence. A Ferranti oil break switch of 600 kw. capacity for alternating current work; a very compact form of starting switch and resistance for use with the Ferranti boards, and Ferranti edgewise ammeter in insulated case, intended for use on boards with pressures up to 10,000 volts. The main coil is outside the case, and entirely insulated from the moving parts of the instruments. A group of Ferranti continuous-current meters were exhibited, also a 75-ampere-meter in parts. These meters are fully described and illustrated in pamphlet No. 152, issued by Messrs. Ferranti, which can be obtained on application.

Messrs. Ferranti also exhibited a piston rod, crosshead, and connecting rod of one of the four 2,500-I.H.P. engines which they have in hand for the London County Council tramways.

The exhibit of the **Bergish Steel Foundry,** of 39, Victoria Street, S.W., included a good selection of steel castings of high finish and uniformly dense texture. Samples were shown of main line and tramway truck sides, some of which are cast of weldable steel to enable truck makers to stock them and use them for various wheel bases by splicing them with a suitable length of flat rolled steel. The tensile strength of these castings is given as 28—35 tons per sq. in. with an elongation of 15—20 per cent. in 8 in. Other samples illustrated what surface hardness can be obtained on such castings, when tensile strength and elongation are not required to be so high. The tensile strength of very soft castings can be raised to over 65 tons per sq. in. The suitability of this material for tramway and railway wheel centres was illustrated by some finished samples showing the high polish obtainable with it. Some of the samples were twisted in a remarkable way to show the treatment this steel will stand in its cold state. The elec-

D

tric motor castings show thicknesses of § in. close to the thickest parts of the castings. The machined surfaces indicate evenness, freedom from blowholes, and even softness throughout. The percentage of carbon is stated to be below 0·2 per cent.

Of special interest to tramway engineers was the firm's "H. B." combined (compressed air) braking, sanding and life guard lowering apparatus, to which we made brief reference last week. It consists of geared compressor, compressed air reservoir, regulator and controller valve, brake cylinder, sanding tubes and fender cylinders. The controller valve has six positions:—Moving the handle to the right of No. 3, the "stop" position, "exhaust" and "sanding" positions are reached. The latter are for the purpose of sanding the rails before starting, or while ascending an incline. Moving the handle to the left of the "stop" position, the first "braking" position is reached, and then the second "braking" position. With both of these movements automatic sanding of the rails takes place. Should there be danger of a person getting under the car, the controller valve would be moved beyond the second "braking" position, and compressed air admitted to the fender cylinders, whereupon the guard would be rapidly lowered and held down with a force of up to 100 lbs. This effectually prevents limbs of persons getting below the fender. It is difficult for the car driver to make a mistake with his apparatus, as he cannot "brake" without sanding, and cannot lower the life guard without

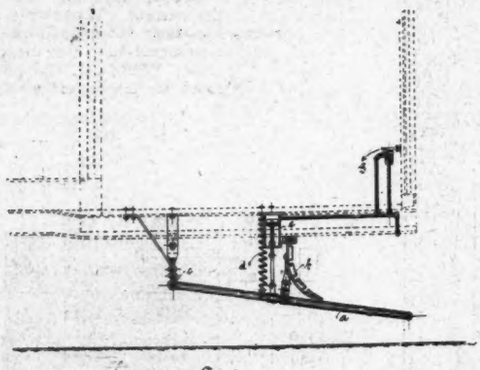


Fig. 1

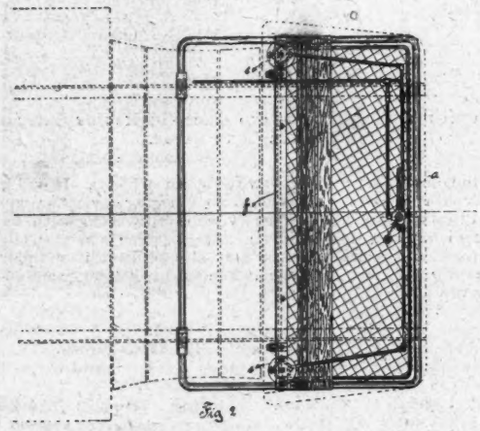


Fig. 2

Bergish Life Guard, Operated by Compressed Air. Fig. 1, Elevation; Fig. 2, Plan.

having first passed the "brake" positions. The automatic sanding of the rails, when braking, is, of course, a great advantage on greasy roads, where the best brake would be of no use unless sanding was done at the right time and place. The weight of the apparatus is given as below 4 cwt. Locking of the wheels can easily be avoided by setting the regulator valve at a moderate pressure. The brake cylinder with this pressure must be incapable of locking the wheels under any circumstances.

As advantages generally inherent to compressed air brakes, it is claimed that the source of energy supplied to the brake is independent of the current supply, and therefore available not only while the trolley is off the line, or the motor switched off, but also when the car is moving at a very low speed, which would not be sufficient to use the motor as generator for braking purposes; the air gauge in front of the driver is of great moral importance, and the whole apparatus is so simple and easily understood in all its details by drivers, that panic is declared to be out of the question. Practical results are claimed to support this theory. Another advantage claimed for such brakes is that the motors are allowed to cool down while the car descends hills, and motor repairs are greatly reduced.

Fuller details of this apparatus are given in an illustrated pamphlet issued by the firm, from which we gather that there are over 2,500 equipments in use, and over 1,800 trucks fitted with it on the Continent alone. Special success is claimed for it in Berlin, where, after a trial of three years with 100 cars, the system has been extended to 700 cars. The chief engineer of the Berlin Tramway Co. mentioned this brake at one of the meetings of the recent International Tramways Congress, and spoke very favourably of it. We are informed that the brake can also be arranged as an automatic brake, not only as regards braking and fender-lowering arrangement on the motor cars, but also with regard to the trailers. For this purpose the trailer would have to be fitted with its own air reservoir, and with a tap or valve which would close automatically whenever the drawbar snapped. The closing of this valve would have the effect of putting the trailer's brakes on automatically. This system is not concerned with any particular brake block, and is stated to be equally suitable for wheel, track, or other brakes.

The United States Metallic Packing Co., Ltd., of Soho Works, Bradford, exhibited working models of their metallic packing, which is in service at some 70 electric lighting and power stations, including such plants as that at Manchester, where the engines at all three stations, Dickinson Street, Bloom Street, and Stuart Street will be equipped with this device. The packing has been very extensively adopted for the largest and most powerful of the recent additions to the British Navy, and there was on exhibition a set of internal parts, duplicates of those supplied for H.M.S. *Terrible*. On the European Continent and in this country the system is running with steam superheated to 700° F., and with steam pressures up to 300 lbs. per sq. in. The company also exhibited their portable power drill, which works with steam or air. This machine is one of the most powerful of its class now on the market; it can drill a hole 1 in. diameter, 2¼ in. deep in cast-iron in 30 seconds, with an air pressure of 80 lbs. per sq. in. Other exhibits were the Monarch pneumatic chipping and caulking hammer, and the C. and I. portable electrical drill, which was shown in operation. This machine consists of an electric motor, sliding shaft and universal movement drill head. The motor is carried on two horizontal centres by a frame which may be moved at will in a complete circle on the carriage proper of the motor. On the top of the motor is a bracket carrying a hollow shaft, provided at one end with a spur wheel, which is driven from a pinion on the armature shaft. Through the hollow shaft slides a long shaft, the extreme end of which is connected with the drill head. The long shaft is slotted for nearly its whole length to fit a key on the inside of the hollow shaft. Thus the motor drives the hollow shaft by means of a pinion and spur wheel, the hollow shaft drives the long shaft by means of the key and slot, and the motion is transmitted to the drill head. The drill head is constructed with two pairs of bevel wheels (four wheels in all) in such a manner that the drill may be turned through a complete circle in a plane at right angles to the long shaft, and through an almost complete circle in the same plane as the long shaft. The switch for stopping and starting is fixed direct on the drill head, thus giving instant control to the man who is drilling. With this apparatus it is possible to drill in almost any conceivable position; the motor may be in any position on the ground, or detached from its carriage (which can be done instantly) and slung up in the air. The power of the drill is 1½ B.H.P., and thus will take approximately 1,300 watts. The cost of electrical power per B. of T. unit in most English towns with corporation supplies, averages 1½d. per hour, so that the energy to run the drilling machine will cost less than 2d. per hour.

Messrs. Doulton & Co., Ltd., of Lambeth, S.E., were, of course, in evidence with their so extensively used stoneware conduits for electric lighting and tramway systems; also troughs for laying cables on the solid system, insulators for lighting and traction work, their patent water-softener, and other familiar lines. One of the items shown was a full-size section of an 18-way conduit, constructed of three-way ducts built up in concrete, as carried out by them for various electrical tramways.

Messrs. Fleming, Birkby & Goodall, Ltd., of Liversedge, York, showed their patent oilless (carbonated) trolley bushes or bearings, and overhead pulleys for tramway propulsion, which are being largely used by tramway engineers, because of their "oilless" lubricating qualities which ensure cool running with economy and durability. In the accompanying figure we show one of the bearings, as supplied for machinery shafting, motors, turbines,

Oilless Carbonated Bearing.

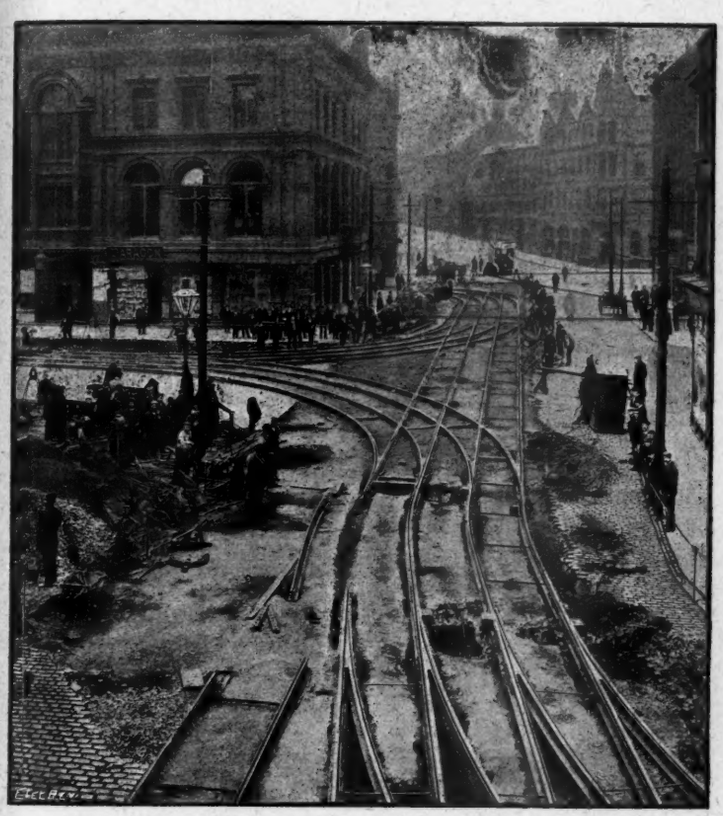
engines, &c., the principle being applicable to every type of rotary or sliding motion. Several styles of the Birkby trolley were on view, one being the self-righting head, fitted with complete or partial swivelling motions, also for swivelling on a steel ball instead of the usual flange; another employing Birkby's patent disc trolley wheel, in which the centre or wearing part can be renewed without necessitating the scrapping of the remainder of the wheel.

The Glacier Anti-Friction Metal Co., Ltd., of 91, Queen Victoria Street, E.C., showed their glacier anti-friction metal, which is especially suitable for lining truck brasses, armature bearings, and, in fact, the bearings of all classes of high-speed

electrical machinery. It is being used by a large number of English and French tramways. They also made a display of finished brasses lined with glacier metal.

Messrs. Babcock & Wilcox, Ltd., of Oriel House, Farringdon Street, E.C., showed a model of their well-known water-tube steam boiler, fitted with a B. & W. patent superheater.

The Hadfield's Steel Foundry Co., Ltd., Hecla Works, Sheffield, showed samples of the Hadfield's improved patent point, 100 ft., 200 ft. and 250 ft. radius, for ordinary girder rails and for the Demerbe rails, points fitted with a manganese steel renewable intersection piece and connected movable points. The Hadfield's improved patent points exhibited were made throughout of Hadfield's patent manganese steel, a material which is exceedingly tough and extremely hard. This unique combination renders it practically unmachineable, and the most durable material in the market for tramway points and crossings. It has been adopted in this country by many corporations for their special work. This point, which can be supplied in any length from 5 ft. 6 in. to 15 ft., is so designed that the tongues are of the maximum strength consistent with smooth running, inasmuch as they are the same width on the base for their full length, instead of tapering towards the toe, as is usually the case. To give this increased bearing, the body of the points is undercut on each side. Another advantage is, that at the ball end a mild steel renewable bush is introduced, which is machined to fit the tongue, and a snug on each side of the point makes it impossible for the tongue to move out of its proper position. The box on this type of point gives satisfactory drainage, and is so arranged that it is suitable for the mechanism of either a movable or an automatic point; the conversion from one to the other can be performed in a few minutes without interfering with the track or interrupting the ordinary car service.



Hadfield's Special Work at Bradford.

Several examples of the Hadfield and Hatton type of combined sole-plate and crossing were shown. It can be fixed in position very readily, the amount of material on the surface is reduced to a minimum, and efficient anchorage is obtained. Hundreds of these crossings have been supplied to the principal corporations in the country.

The drain rails and drain boxes exhibited were of the Hadfield patent design, of which a considerable number are in use; besides giving efficient drainage, the box is also an effective gas trap. Photographs were shown illustrating some of the special track work constructed and supplied to, amongst others, the following Corporations:—Sheffield, Bradford, Nottingham, Cardiff, Doncaster, Stockport, Newcastle-on-Tyne, &c.

We give a view of a complicated lay-out put down at Bradford by Messrs Hadfield.

The Hadfield's special car wheels shown were of the most improved type, composed of a cast-steel centre and fitted with a rolled-steel tire. The makers have supplied several hundreds of these car-wheels, none of which, they say, have failed to give satisfaction, and they are prepared to guarantee their mileage. This, of course, varies according to the gradients on which the wheels are run.

On Stand No. 85 were exhibited a set of Hadfield's car wheels which, for every ⅛th in. wear per side, have given a mileage of miles. Up to date, although only about half worn out, they have 35,000 miles. Another interesting feature of these wheels is the fact that they have never been in the lathe, and the tread and flange are still in good condition.

Several designs of tie-bars are shown. Other items included in the Exhibition were illustrations of various types of joints, samples of best cast-iron brake-shoes, best toughened cast-steel flangeless wheels suitable for tar wagons and barrow wheels, as well as cases containing samples of the various classes of hammers, picks, saw blades, chisels, tools, &c., which Messrs. Hadfield are in a position to supply.

At the stand of **Messrs. Foxcroft & Duncan,** of Queen's Road, Dalston, a large variety of measuring instruments were exhibited. These included ammeters and voltmeters for central stations, of the sector pattern, with illuminated dials; dead-beat moving-coil instruments of the edgewise and circular patterns; spring and gravity-controlled instruments, hot wire voltmeters, and portable instruments of various types. The figure herewith shows one of their latest type of moving-coil dead-beat recording instruments for direct current. Other exhibits were examples of their hatchet and quick-break switches, auto. cut-outs and circuit-breakers, "Phœnix," "S.S." and "Sappho" open and enclosed arc lamps, and switchboards.

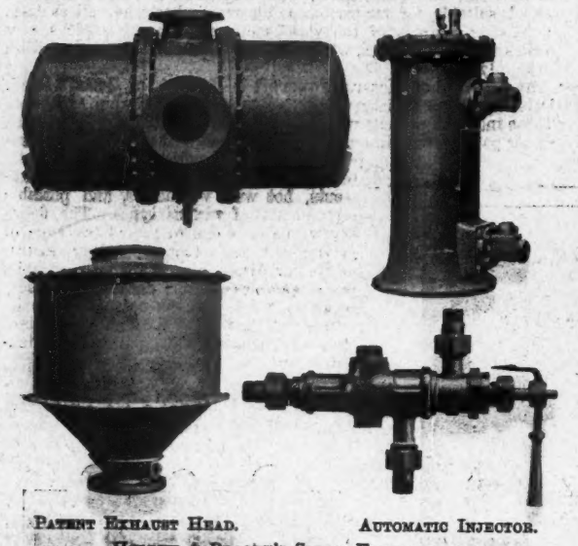
Foxcroft & Duncan Dead-beat Recording Instrument.

Messrs. Francis Morton & Co., Ltd., Garston, Liverpool, showed steel poles for arc lamps and telegraphs constructed of riveted steel tubes with cast-iron bases, which screw on the bottom tube for fixing into the ground. These poles are made of lengths from 15 to 60 ft., 3 in. diameter at the top, and tapering at the rate of 1½ in. in 8 ft. Over three-quarters of a million similar poles have been supplied to the telegraph department of the Indian Government by the company. Photographs and models of car sheds, iron buildings, fencing, &c., were exhibited, and specimens of unclimbable railings and gates.

The swinging conveyor shown in operation by **Mr. G. F. Zimmer,** of 82, Mark Lane, E.C., was a remarkable device. It consisted of two long troughs, mounted on numerous inclined spring legs; these were kept in rapid oscillation by a small crank and connecting rod, driven by a belt and pulley. The material to be conveyed was simply placed in the troughs, along which it travelled at a steady speed, the two troughs being arranged so as to carry the same material round indefinitely. Such trough conveyors can be built 300 ft. in length in one piece; they take very little driving power, have no bearings to lubricate (except the two which carry the crank shaft), and require no attention. The conveyor can be inclined at a considerable angle with the horizontal, without interfering with its working, and is suitable for carrying all kinds of solids, as well as coal and ash.

Messrs. Holden & Brooke, Ltd., of Sirius Works, West Gorton, and 110, Cannon Street, E.C., brought prominently before tramway power station men their steam fittings and specialities. Their exhaust steam feed-water heater has recently been adapted for the Manchester, Kalgoorlie (W.A.), and other electric generating stations. One of these, of the vertical pattern, for 150 gallons of

water per hour, and one of horizontal pattern for 100 gallons, were shown. The advantages of this heater are a floating head, with straight tubes free to expand and accessible internally for cleaning out scale so as to enable the efficiency of the apparatus to be maintained. The oil separator and automatic discharger forming Brooke's complete system for the automatic extraction and ejection of oil from exhaust steam were exhibited. The discharger was shown in operation under vacuum, and provided with glass casing to exhibit the working of the automatic gear. The discharger is

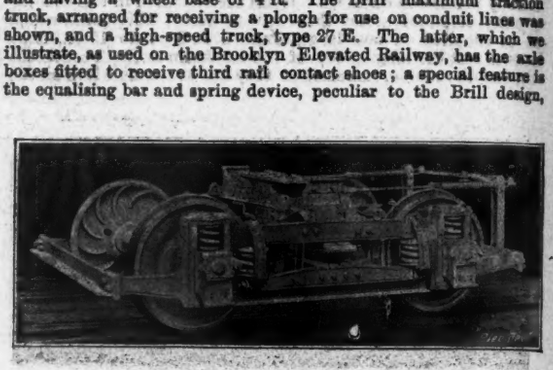


Holden & Brooke's Steam Fittings.

employed to automatically eject the collected oil and water when the separator is placed between the engine and condenser. It will also drain exhaust main pockets, "triple effects," or other chambers under vacuum, and live steam may be admitted to assist the discharge. The exhaust head is for attachment to the open ends of exhaust pipes, and prevents the ejection of grease and water upon surrounding roofs and walls. A number of these exhaust heads are at work on municipal electricity stations. Other exhibits at this stand were Brooke's patent separator or steam dryer, "high-pressure" steam trap, and the Sirius injectors.

At the stand of **Messrs. Estler Bros.**, of 25, Laurence Pountney Lane, E.C., there was a good deal of "Ambroin" line material such as is doing service on many of the more important tramway systems in the country; third rail insulators, trolley standards, Wilkinson's patent trolley head, feeder pillars and section boxes, also the Garton lightning trolley arresters, but the more impressive features were the Taylor truck and the Hewitt and Rhodes pneumatic slipper brake. The Taylor truck has no solid forged side frames, but these consist of standard sections of steel, the advantage being that when repairs are required to be made owing to accident or ordinary wear and tear, they can be readily carried out without waiting for special costly forgings. All parts of the truck are lipped and shouldered, one piece resting on another, and arranged to take the strain edgewise. The various parts of the truck are held together by heavy bolts and nuts, the nuts being placed on the outside where they can readily be examined. The frame is rigidly connected at the four corners by heavy end bars, which keep the truck absolutely square, and the axles always run parallel to each other. The car body is not bolted on to the side frame, but simply rests on the four full elliptic springs at the corners, and is only fixed to the truck by the bolts in the centre of the two end bars. This arrangement prevents the car body from being strained in any way when rounding curves. The springs are entirely elliptic. The truck frame is suspended at four points on each side, at each end of the half elliptic springs over the journal boxes, through swinging shackles. The experience gained in the construction of railway rolling stock has proved that elliptic springs tend materially to lessen the wear and tear. As the car body is not bolted to the side frame, it is said that not the slightest shock is transmitted to the car. The half elliptic springs receive it, but do not transmit it to the car. This enables the car to ride very steadily with a marked absence of teetering or pitching. The absence of teetering again increases the life of the motors and gears, as the load does not come alternately on the fore and aft motors.

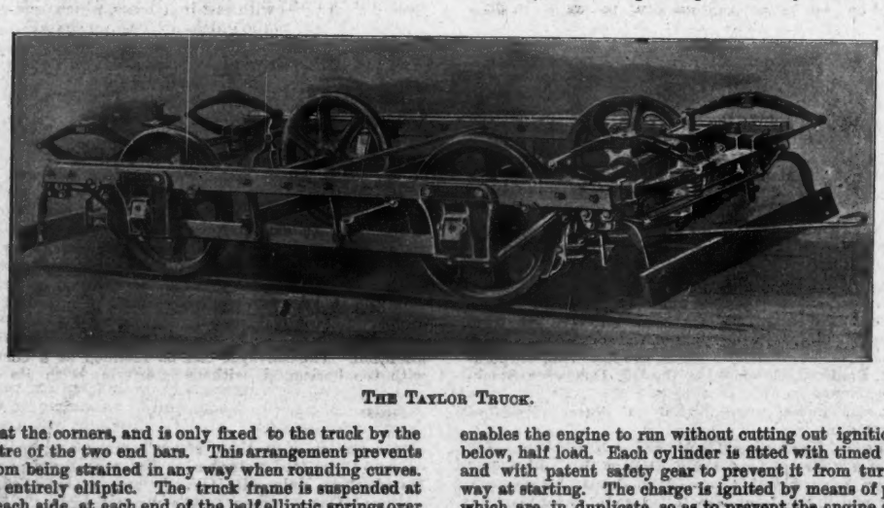
The **J. G. Brill Co.**, of 110, Cannon Street, had a special display of their well-known trucks, of which four were shown. One of these is their solid forged-frame No. 21 E motor truck, with equal wheels, for two motors; another is their 27 G bogie truck, for a four-motor equipment, arranged with the motors outside the axles, and having a wheel base of 4 ft. The Brill maximum traction truck, arranged for receiving a plough for use on conduit lines was shown, and a high-speed truck, type 27 E. The latter, which we illustrate, as used on the Brooklyn Elevated Railway, has the axle boxes fitted to receive third rail contact shoes; a special feature is the equalising bar and spring device, peculiar to the Brill design,



Brill High-Speed Truck.

and well shown in the figure. It is claimed that this system of spring-suspension reduces the tendency of the car to roll on the springs, and gives greater lateral stability to the car body, the spring base being exceptionally wide. The equalisers, carried by spring links as shown, have the effect of making the motion of the car body only half as much as that of the wheel in passing over joints in the rails, &c. This is regarded by the makers as the greatest improvement in spring-suspension yet devised. These trucks are specially suitable for high-speed electric railway service, and have been applied on various American railways and tramways.

Messrs. Crossley Brothers' exhibit consisted of a double-cylinder vertical gas engine coupled to a dynamo for electric lighting; one of their standard high-speed electric light gas engines of about 30 actual H.P., with starting apparatus; one of their ordinary low-speed gas engines of medium size, about 20 actual H.P.; one of their smallest gas engines, known as the "H" type, or ¾ actual H.P.; and an oil engine of type "UU," of 23 actual H.P., complete with its starter. The most important of these exhibits, and the greatest novelty, is, of course, the vertical engine, which was the first of its kind exhibited by this firm. It has many features of great interest. The engine has two cylinders, with both connecting rods leading on to the same crankpin. The cylinders are 11½ in. diameter by 15 in. stroke, made with water jackets, and fitted with loose liners, in accordance with the firm's usual practice. The engine framing stands on a massive casting. The crankshaft is made of mild forged steel cut out of the solid. An outside bearing is provided, and a pedestal, for carrying the outer end of the crankshaft. The engine is fitted with an efficient high-speed governor, by means of which the speed can be adjusted at pleasure, and which automatically regulates the consumption of gas in proportion to the load on the engine. In addition each cylinder is provided with an automatic cut-off valve under control of the governor, which regulates the power given out by the working strokes, and enables the engine to run without cutting out ignitions down to, or below, half load. Each cylinder is fitted with timed ignition valves, and with patent safety gear to prevent it from turning the wrong way at starting. The charge is ignited by means of porcelain tubes, which are in duplicate, so as to prevent the engine stopping in the



The Taylor Truck.

event of one tube breaking. Very efficient lubrication is provided, the oil being pumped to an oil box, from which it is distributed by means of pipes to the various parts. The engine has a heavy fly-wheel 7 ft. diameter by 21 in. wide. It is built for giving off about 56 B.H.P. when working with producer gas, at a speed of 250 revolutions per minute. Crossley's patent starter is provided for starting, and the engine has all the usual accessories, such as gas bags, silencers, &c. The mechanical efficiency of this engine is guaranteed not under 85 per cent., and the variation in speed, both cyclical and governing, when running at a load between half-power and full power, will not exceed 1 per cent. The engine is coupled by means of one of Raffard's patent elastic couplings to a Mather & Platt multipolar shunt wound dynamo. A very neat and light wrought-iron platform is provided, with ladder, &c., for getting to the cylinder and higher working parts of the engine.

Referring to the firm's other exhibits, the high-speed engine is built with a single heavy fly-wheel 6 ft. 9 in. diameter, and has all Crossley's recent improvements. The small engine is a comparatively recent addition to Messrs. Crossley's list of sizes; it was designed with a view to meeting the demand for an engine of very small power, particularly for amateurs' use, and is capable of giving a maximum of 1 H.P. actual. Its consumption of gas is in proportion to the work required, and it occupies a very small space, 3 ft. in length by 2 ft. 5 in. in width. The oil engine is on similar lines to that which obtained the first prize at last year's Royal Agricultural Society's trials at Cardiff, except that it is stationary instead of portable. It has two fly-wheels, 5 ft. 6 in. in diameter, and runs at a speed of 180 r.p.m., the consumption of oil being under three-quarters of a pint per actual H.P.-hour at full load; this engine, we understand, has the merit of being highly economical under varying loads, and great numbers are being used both at home and abroad.

The **Harburg India-rubber Comb Co.**, of Hamburg, represented by Mr. F. Winter, of 8, Redcross Street, E.C., showed accumulator boxes and various other ebonite productions used in electrical engineering, and an ingenious type of insulator for overhead trolley lines. This consisted of iron links completely enclosed in "Griffin" insulating material, a special kind of ebonite vulcanised on to the metal; the ends of the links

"Griffin" Link Insulator and Ear.

are gripped in iron or gun-metal straps. Used alone, these form link strain insulators; used in conjunction with ears bolted through the link, as in the figure herewith, they become double pull-off link suspensions, double insulation being necessarily provided in each case. The insulators thus formed are both mechanically strong and very light; it is stated that 1¼ millions of these have been sold during the last few years.

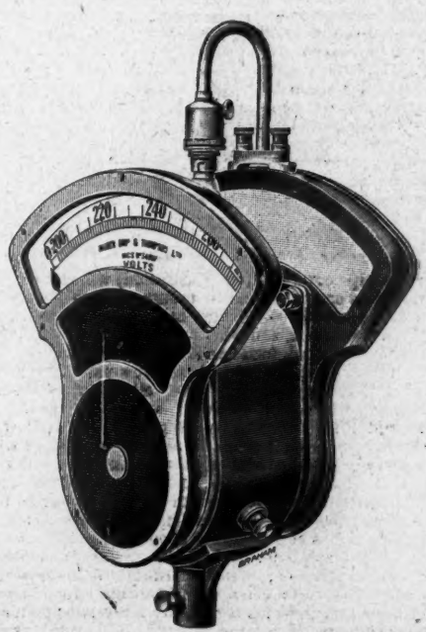
The **Western Electric Co.**, of 171, Queen Victoria Street, E.C., had a very varied exhibit, including ceiling and desk fans, arc lamps, open and enclosed motors, paper-insulated and other cables, telephones, and traction material. A handsome portable telephone set for field work was shown, as well as the Western Electric system of tramway telephones, exchange and private line instruments, &c. Samples of cables laid in wooden and earthenware troughs filled up with compound, feeder pillars, joint boxes, &c., were also exhibited. Judging by the temperature at the time of writing, we should say that the large fans shown would be the most highly appreciated exhibits at this season.

Messrs. Askham Bros. & Wilson, Ltd., of Sheffield, had a striking display of steel work. A special feature was the automatic movable point, which can be changed from the automatic spring type to the movable type in one minute. Various patent movable points, silent automatic points, drain rails and boxes, and examples of automatic spring points made for a great number of the principal tramway systems of this country were shown; a map of Great Britain, showing the places where Messrs. Askham's special work is in use, was an impressive witness to their activity, while a number of photographs and drawings illustrated the details of some of the lay-outs constructed. Special steel joint plates and heel plates, tie-

Askham Bros. & Wilson's Special Work at Oldham.

bars, wheels and axles, platelayers' tools, &c., form parts of this most comprehensive exhibit. The illustration herewith shows a portion of the special work at Oldham, carried out by Messrs. Askham Bros. & Wilson, Ltd.

Messrs. Nalder Bros. & Thompson, Ltd., of 34, Queen Street, E.C., had an excellent exhibit of instruments of all kinds, and of circuit-breakers, &c. Amongst items of special interest, there was a large station voltmeter with double illuminated dial, which can be turned so as to face in any direction, and is a very convenient form of instrument for central station engine rooms. A Board of Trade panel was also exhibited, containing an ammeter, voltmeter, and the recording instruments necessary for making the tests prescribed by the Board of Trade. A feature of interest on this panel

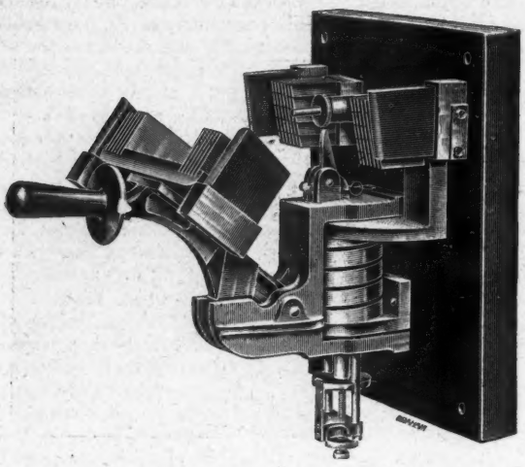


Nalder Bros.' Double-Face I.D. Sector Voltmeter.

is a special earth automatic, provided to protect the ammeter in the event of the passage of a large current to earth; if the current exceeds the safe reading of the instrument, the automatic short-circuits the ammeter, thus preventing all damage which might otherwise arise.

There were several forms of switchboard panels exhibited; there was a generator panel, containing ammeter, minimum reverse current circuit-breaker, field regulator and D.P. switch, and voltmeter plug for plugging on to the station voltmeter, for paralleling the incoming machine; a feeder panel, containing ammeter, voltmeter, and maximum circuit-breaker and switch; and a motor panel, containing starting switch, maximum and no-volt circuit-breaker, and the necessary instruments. There were also numerous portable instruments, both recording and of the direct-reading type, and high pressure voltmeters of various patterns, as well as large edgewise illuminated instruments, which can be made for either direct or alternating currents. A large number of circuit-breakers,

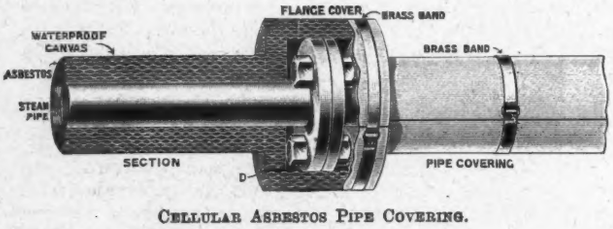
designed for almost very possible requirement, were shown, such as plain overload or minimum reverse-current type, overload and



Nalder Bros.' Maximum Circuit Breaker.

underload combined, overload with no-volt release, and a small type of circuit-breaker, of which forms are made in any of the combinations described for the larger type.

■ **The United Asbestos Co., Ltd.,** of Dock House, Billiter Street, London, E.C., the oldest firm in the European asbestos trade, had a most interesting exhibit of all kinds of asbestos goods, india-rubber goods, lubricating oils and greases, engineers' tools, boiler fittings (asbestos packed and plain), and all engineers' requisites. A large display was made of the company's well known patent "Eclipse" and "Gladiator" packings, and "Victor" metallic jointing materials, which we are given to understand have been in continuous use in H.M. Navy for 15 or 16 years past. A new departure



Cellular Asbestos Pipe Covering.

in boiler and pipe coverings (see illustration) was also on view. It is constructed in such a way as to ensure a large amount of confined air being around the boiler or pipe, which in itself is an excellent non-conductor, and when in combination with the corrugated asbestos millboard, forms an ideal covering material. Among a large collection of engineers' tools, the new patent "Salamander" self-centring vice is interesting. It is well worthy of the attention of all engineers who have occasion to use machine vices.

The Patent Fibra Pulley Covering Co., of 217, Euston Road, N.W., showed two iron pulleys on a shaft, one faced with their special material, the other with a naked iron face; with the aid of a short belt and a set of weights, these were used to demonstrate the greater coefficient of friction with the Fibra covering than with the bare metal, the ratio between tight and slack side tensions when slipping begins being given as about 2·5 : 1 without the covering, and from 6 : 1 to 9 : 1 when the pulley is covered. The reduced bearing friction, increased life of belting, and greater power transmitted with a given size of belt are strong arguments in favour of the covering, which is specially recommended for use with electrical machinery.

The Crosby Steam Gage and Valve Co., of 147, Queen Victoria Street, London, E.C., who are the makers of the well-known Crosby steam engine indicators, had a showing on the stand of the Sturtevant Engineering Co., Ltd., of indicators and other steam specialities. They had a collection of five indicators coupled together electrically, showing how diagrams can be taken on five indicators simultaneously by operating one indicator only. The new reducing gear lately brought out by the Crosby Company was also on view. This reducing gear is attached directly to the indicator cock below the indicator, and provision is made for adapting the apparatus to strokes from 10 in. up to 72 in. by means of a nest of aluminium pulleys, which are attached in a convenient form to the main spindle of the reducing gear. The spring which provides for the return stroke of the drum is of spiral type instead of the coil spring attached on other gears. As being a new thing in pressure gauges, the Crosby improved pressure gauge was shown, fitted with two Bourdon tubes, an arrangement which allows of the use of stouter tubes and fittings. The Bourdon tubes are attached to the gauge by means of screwed joints, no solder or brazing material being used. The base casting to which the tubes are screwed is carried up to the centre of the gauge, and supports the quadrant and levers. This gauge has been found to be very suitable for high pressure steam, especially in positions where the gauge is subjected to a great deal of vibration. The renewable seat valve having V-shaped seats, known as the Crosby "spring seat" valve, which was well represented, has been successful when used with superheated steam. Many samples were shown of Crosby "pop" safety valves, sight feed lubricators, chime whistles, water relief valves and other steam fittings, also pressure recording instruments of various kinds. A convenient form of pressure recorder is that in which a circle of graduations surrounds the recorder chart; the gauge pointer records the actual pressure at any moment, while the pen arm makes a continuous record upon the chart. The Chapman Fullway gate valves, for which the Crosby Company are the sole agents in this country, were shown for pressures from 60 lbs. to 250 lbs. These valves are similar to those now being fitted in many of the steam mains of large electric lighting installations.

The "New London" dry seat for the tops of electric cars and outdoor use generally was shown by the patentee, **Mr. Hu. Crichton,** of 4, Derby Road, Liverpool. This seat is being tried on some of the leading tramway systems in the country, and it will perhaps be remembered that it secured the prize in the competition at the Exhibition held in 1900. It is an automatic reversing seat, which can be made rigid in fine weather, with a reversing back. There are no intricacies in its action, and nothing to readily get out of order. Since the seat was introduced to the public in 1900 a number of improvements have been effected. An important feature is that, after considerable experimenting, the adaptation of the "New London" principle to ordinary electric-car seats has been successfully accomplished. Ordinary Slath seats can now be converted into "New London" seats at a moderate cost, without removing the seats from their position.

Card index systems, which might with advantage find a more extensive use in electric lighting and tramway undertakings, are shown by the **Lyle Co., Ltd.,** of 26, Harrison Street, W.C., who will send a set of catalogues on application; also by the **Library Bureau, Ltd.,** of Bloomsbury Street, E.C.

Messrs. D. Bruce Peebles & Co., of Edinburgh, maintained the excellent reputation they have established at all exhibitions where they have been in evidence. Quite an interesting collection of electrical machinery and parts had been brought together in an attractive way. Their three-phase standard P.P.P. motor (350 B.H.P., 5,000 volts), for coupling direct to a sub-station tramway generator, was prominent. It runs at 240 revolutions per minute, 42 periods, and the design is similar to that supplied to the South Wales power scheme. Their standard 300-KW. traction generator formed a most appropriate exhibit, for machines of this type are on order for many tramways. The motor armature and bearings for a 100-B.H.P. electric locomotive (500 volts) were shown so that the motor chord windings might be inspected. An 18½-H.P. three-phase crane crab motor, also motors for wiring and other work, a milking booster, and many other things were to be seen.

(To be continued.)

THE REPORT OF THE COMMISSION ON WATER-TUBE BOILERS.

This report, now issued, is not very much in advance of the interim report, and suggests a curious inconclusiveness of ideas on the part of the Committee, who are able to confirm the opinions they expressed in the interim report. The Belleville boiler, though it stands condemned, is let down easily. It is interesting at the moment to learn that the Messageries Maritimes Cie. have rejected the Belleville boiler, especially as it was this company's use of the boiler that was always held up as a proof that it was to British ignorance that the failure of the boiler in our Navy was due. There is, however, in the report a list of comparative disadvantages of the Belleville boiler, which are in brief:—

Defective circulation and uncertain water-gauge indications.
Delicate automatic feed apparatus necessary.
Great excess of pressure in pumps.
Great excess of pressure in boiler over that of engines.
Varying quantity of water in boiler with rate of combustion.
Separators and blow-outs on main steam pipe to deal with priming.
Constant and excessive loss of water.
Tube corrosion.
Costly upkeep.
Additional evaporator plant and excessive coal consumption.

Against these very serious defects are placed the following advantages:—

Less delay in steam raising.
Less damage if struck by a projectile.
Greater ease of renewal and repair.
Less weight. High pressure.
Greater area of fire grate.
Several of these advantages are doubtful.

The Committee name a few other water-tube boilers that do not possess, in their opinion, such a plethora of vice as the Belleville, and they give a list of 36 boilers they have had under consideration, some of which they name as suitable for trial in large vessels and others they name to be watched carefully. Generally, we cannot think the selection altogether happy, and whether from their being not altogether free agents or some other cause, the report does not read

as one would expect with a report from men, some of whom at least are practical.

The sting of the report lies in its tail, for while expressing so much unbelief in the water-tube boiler, they recommend its adoption for that portion of the equipment in excess of ordinary cruising power. For ordinary cruising speeds the old friend—the cylinder boiler—is recommended, so that a ship-of-war will be more comfortable in the piping times of peace and less so when it comes to fighting. The water-tube boiler is, in fact, to be coddled and kept clean until the enemy heaves in sight; steam is then to be got up, the enemy we hope, sent to the bottom, and the water-tube baby wiped dry and put to bed until enemy No. 2 comes along, and so on.

The cylindrical boilers, it is added, should have special means of circulating water while getting up steam. Here, at last, is a gleam of sound advice.

Thus ends the second chapter in the chronicles of the water-tube boiler in the Navy. There is a more or less lame and impotent air about the matter, but it really is to be hoped that it will effect the purpose one hoped to have seen effected by the interim report—to wit, the actual dropping of the Belleville boiler. This did not occur, and the *King Alfred*, to quote one case only, was converted into a junk ship in direct contradiction of the interim finding, and is, we suppose, a practical cripple among ships before she has moved.

The attitude of the Admiralty has been very curious. To admit an error is evidently beyond them.

The Belleville having been disposed of, it is to be hoped that greater care will be exercised as regards future water-tube boilers. We see very little grip of the subject in the report. The best boilers named more particularly are accorded the least showing.

The country should demand now that the engineers of the Navy be reorganised, and their fearful deficiency made good, or trouble will ensue. The eye of the foreigner is on our trade, and he only holds his peace because of the Navy.

THE GROWTH OF FUEL.

By W. HIBBERT.

In the beginning of April some account was given of an article by Prof. Perry on the "Misuse of Coal." The point of his writing was that we in England are surely getting towards the end of our available stock of coal, and yet we are content to transform it into power by a method which yields only about 10 per cent. of the theoretical.

On this Prof. Perry founded a plea for a national effort to find a new way of using our exceptionally good stock of coal, so that our advantage might be prolonged by virtue of greater economy.

The plea has drawn one or two replies. Mr. Rosenhain wrote to *Nature* to point out that there were other natural resources of energy, the chief being sunshine. Solar engines might easily be made to satisfy a large demand, and thus tropical and sub-tropical countries would be able to utilise much heat energy now wasted. But Mr. Rosenhain also pointed out that it was possible to grow fuel as we wanted it, just as we grow our food. Quite well-directed efforts are being made in France and Germany to use alcohol for motor cars and other power purposes, the idea being that spirit is a form of fuel, the growing of which may become a national industry.

The bearing of this most interesting fact receives strong reinforcement in the statements of a letter from Mr. D. E. Hutchins, of Cape Colony.

Sir D. Brandis and Mr. Hutchins showed long ago that the eucalyptus tree could be grown for wood fuel at the rate of 20 tons (dry weight at 60 lbs. per cubic ft.) per acre per year in perpetuity. The climatic conditions of sun and rainfall to produce this are to be found on about 8,000 million acres of the earth's surface (about one-fourth of the whole). In Germany, one-fourth of the total area is under forest, and this is held on the highest authority (on forestry) to be the suitable proportion for a thickly peopled civilised country such as Germany. Taking this proportion of suitable land areas, the possible maximum annual output would be 40,000 million tons of wood. Or dividing by two to get an average instead of a maximum yield, the figure becomes 20,000 million tons annually. This is more than 30 times the world's present consumption of coal.

No wonder that Mr. Hutchins speaks strongly of our national neglect of forestry. He overlooks, however, the effect produced on us by our exceptionally easy access to coal. Even in South Africa where it is cheaper to plough the ground and plant a forest of quick growing trees than to import coal from over the sea, or by a long and expensive land journey, fuel wood is worth nearly 1s. per cub. ft. At the diamond fields, before the advent of the railway, firewood fetched 1d. per lb. These prices indicate the improbability of the plough replacing the miner's pick as long as the price of coal is as low as we find it to be in England.

As a matter of fact, these counsels of Mr. Rosenbain and Mr. Hutchins really strengthen Prof. Perry's position. For there can be no doubt that the Professor was concerned mainly with our British outlook, and this depends largely on our exceptional mineral resources. As the present writer has pointed out, the prospect of growing fuel as it is wanted, is not quite so rosy as it appears. Sir W. Crookes has shown cause for thinking that our ability to grow food for the increasing population of the world is rapidly approaching a critical phase. The promise is that we shall not be able to do so at the present rates of growth if the prevailing agricultural conditions are maintained. These contentions of Sir W. Crookes have, of course, been challenged as too pessimistic. His figures have also been regarded as untrustworthy. But his position is supported by the natural tendencies which Malthus first enunciated, and which led Darwin on his way to the doctrine of evolution by natural selection.

To electrical engineers these subjects may have an increasing interest. The day may come when electrical energy will be the very handmaid of the agricultural worker, and our supply of cabbages depend on our efficient use of a proper electric arc. An immediate deduction from Prof. Crookes' contention was the necessity of "intensive" cultivation of the soil. Given proper "fertilisers," the present yield of the soil can be enormously increased. Helmholtz has shown that only about $\frac{1}{1477}$th part of the sun's energy is found in the vegetable products grown under it in Germany. In South Africa, India, &c., this might be made as high as 1 per cent. by proper choice of plants. But even here the vegetation outcome can be increased five or six fold by a proper application of nitrates to the soil. But nitrates are too dear at present, and Sir W. Crookes indicated that the special form of the electric arc in which nitrogen is burned to oxides and nitric acid, might come to the rescue. It is only a few years since he made this suggestion. Lord Rayleigh made a bold effort to carry it out in practice. As the reader of this is probably aware, a special feature of Lord Kelvin's recent visit to America was his examination of a large plant at Niagara for converting atmospheric nitrogen into nitric acid or nitrates by the electric flame method. This shows how fast such a contention as that of Sir W. Crookes may affect the practical world, and a few results of Lord Rayleigh's may therefore be re-quoted as a small guide to what is now possible.

Lord Rayleigh, using an alternating arc absorbing about 800 watts, found 25 cubic centimetres of mixed gases (nitrogen and oxygen) combined per watt-hour.

The potential difference between the platinum point during discharge varied from 1,600 to 2,000. Yet a transformer working up from 100 volts to 2,400 was quite unmanageable, the electric conditions being too unstable. The instability may be akin to that prevailing in an ordinary arc, by virtue of which a steadying resistance is requisite. Lord Rayleigh employed a Swinburne oil transformer, with open secondary volts about 8,000, falling to 2,000 or less when the discharge is running. The final arrangement was to have a variable inductance (coil with sliding core) in the primary, by which the volts on the transformer primary were reduced from the 100 of the supply to 30. The current taken was 40 amperes, and the power factor 0·66. The power, therefore, came out as 800 watts as already stated.

If it is necessary or advisable to push forward this method of increasing the food-yielding powers of the soil in order to cope with the demand for food as such, it is evident that there is not much room at present for undertaking the additional task of growing fuel. If the fears as to food supply are at all well founded, the soil area available will have to be so far allotted to that end as to leave less for fuel.

All this is interesting enough to electrical engineers, who cannot afford to ignore it as a possible large development of their industry. But it does not weaken the plea which

Prof. Perry originally put forth, at any rate for British engineers. When these issues of electrical activity are developed, direct sun-power and indirect as represented in water falls will become relatively more formidable as competitors. Nitrates may be produced on the edge of the Sahara, or in other parts of Africa by solar engines running all day; and at Niagara by water power running both night and day. Other issues more or less detrimental to our present advantageous position also arise, and our duty is to conserve all resources. Given a power generating method which would utilise 30, 50 or 70 per cent. of the energy in coal, and we could compete with sunshine and water-power for a much longer time. Prof. Perry wants us to start looking for that method.

THE CASTELLI RECEIVER FOR WIRELESS TELEPHONY.

By H. W. SULLIVAN, M.I.E.E.

The editor of *l'Elettricista* has performed a valuable service in calling attention to the recently proved merits of the new Castelli tube *v.* the ordinary filings coherer for wireless *telephonic* communication. Two forms of the Castelli tube, and the exceedingly simple manner of its connection, are shown in figs. 1, 2 and 3, which are in themselves explanatory.

The best size of mercury globules is from 1·5 to 3 mm. in diameter, and that of the glass tube generally used 3 mm. in internal diameter, and from 5 to 8 mm. in external diameter.

It will be noted that the Castelli tube is in effect a new form of microphone joined up in place of a coherer in circuit with a battery and telephone; the received waves causing

Fig. 2.

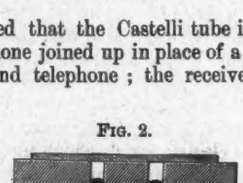


Fig. 1.

corresponding variations in the battery current flowing through the telephone circuit, thus producing signals.

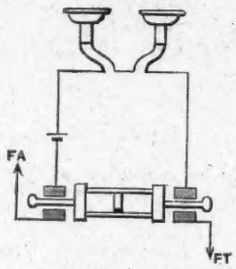
That which impresses one in this receiver is its combined originality and simplicity. Hitherto, inventors generally have followed upon the lines of the Branly-Lodge principle of coherer, and Mr. Marconi, notably amongst others, has improved that apparatus, and by minute attention to points of electrical detail has made of it a commercial article. But the Castelli instrument is a new departure, and would seem to possess certain advantages over, at any rate, filings coherers.

In addition to its simplicity, it is *self-restoring*, and thus requires no tapper or other mechanical device to decohere it after each signal. This greatly increases the signalling speed. Again, a vacuum may be dispensed with, so that it is not necessary to exhaust the tube. Then, again, it is said that in case of need the operator himself can clean and efficiently re-charge the tubes—an enormous advantage in practice.

The particulars as yet published scarcely allow of an opinion being formed as to the life of the new receiver or as to its behaviour in practical working from day to day in all weathers, and especially in magnetic storms.

In a recent article upon wireless telegraphy (see Electrical Review, February 14th, 1902) the writer gave instances within his own observation of the considerable interference experienced in wireless signalling with the state of the atmosphere.

It was also pointed out that the signalling range can be extended within limits by using more and more sensitive coherers, but that, as the sensibility of the coherer is augmented, so also is its susceptibility to atmospheric disturbances. The filings coherer is infinitely more responsive to these disturbances than the most delicate receiving instruments at present used in land or sea telegraphy. Herein, rather than in point of perfect syntony or tuning, with its many problems, would seem to lie *the* difficulty in



F A, aerial wire; F T, earth wire.

Fig. 3.

the way of establishing a service of aerial communication between continents or across great spans of land or ocean. It is natural to suppose that, owing to its extreme sensibility, the working of the Castelli tube would be even more interfered with by atmospheric disturbances than that of the ordinary, and, presumably, less sensitive granular coherer. This, however, remains to be seen. It may possibly prove less responsive to the state of the atmosphere than the original Varley lightning arrester with filings, and its child, the aforesaid coherer.

Without doubt the new instrument is a departure of distinct promise in the development and perfection of wireless telegraphy, in which field so much remains to be done before it can become a practical science capable of competing with orthodox telegraphy.

The shortcomings of the filings coherer are now recognised. It has other drawbacks. Simple as appears to be the construction of this instrument, and much as has been written upon the subject of rendering it precise and constant in its operation, it is exceedingly difficult to make a coherer which will be reliable under all conditions of service. Even when, after endless work and vexatious failures, a reliable type has been finally evolved, it will fail to some extent to respond to signals at long ranges, and there is no certainty that the instrument will maintain its efficiency for the lengthened periods naturally expected of, and common to, other highly delicate apparatus.

In certain cases its very journey to its destination has apparently sufficed to effect some subtle and unfortunate change in its comportment when subjected to actual trial.

Then again, the existing plans of mechanically decohering or restoring the coherer to its normal non-conducting condition after each signal have, of necessity, the effect of limiting the speed of reception, and are more or less crude.

On consideration, it is evident that the troubles experienced with metal filings coherers are fundamental troubles due alone to the principle of their construction, and hence it is that any new and *self-recovering* receiver is of interest.

The disadvantage of the Castelli tube is that at present its signals can be received only on a telephone, inasmuch as in contradistinction to the granular coherer, this microphonic receiver is incapable of closing a local circuit in which is placed a Morse inker or recording instrument.

According to Prof. Banti, the maximum distance at which wireless *telegraphic* communication has been established in the Italian Navy is 70 kilometres, while with the Castelli tube telephonic messages have been exchanged at ranges up to 200 kilometres, and the speed and certainty of signalling were also much improved. The professor quotes from official and recent experiments conducted by Italian naval officers, the results of which were published this year by permission of the Ministry of Marine.

These results are not remarkable as against the achievements of our own Navy, which was the first of all to officially recognise the capabilities of wireless telegraphy with instruments of its own construction,

and in which, prior to the deeply interesting Italian experiments as now published, wireless *telegraphic* messages had been exchanged and recorded on Morse at distances exceeding even the limit of the telephonic communication above mentioned.

CORRESPONDENCE.

Patent Law Reform.

At a meeting of the Institute held on June 5th, the leading article in your issue of February 21st was read and discussed. Satisfaction was expressed at the evidence therein that an important organ of the British Press held views upon the subject of Examination into Novelty of Patent applications which were in accordance with the interests of inventors and of the public.

Our Institute regards the rapid progress of America industrially as due to its Patent system to a considerable extent. The mistake is not made in that system of issuing invalid patents knowingly, nor of granting to foreigners rights which citizens at home (U.S.) are not allowed. The Institute approves of the American system, whereby the whole file of Patent Application documents is open for inspection after the grant. This system tends to ensure that the Examiners shall be competent men, it strikes at corruption, and it enables the public to have information which the Patent Office has elicited at the public expense, approximating the procedure to that of a Court of Law in its doing away with unnecessary secrecy. It is safe to say that there will be less bogus company flotations if all the patent papers are open to public inspection free of charge.

Our Institute has not arrived at the opinion that Patent Agents, and those barristers who appear in the Courts in Patent cases, are the most competent to reliably represent the industrial interests as regards what Patent law should provide for. These gentlemen, it is believed, look at the question from a standpoint very different from that of the manufacturer and of the consumer of patented goods, and it is believed that chairmen of Chambers of Commerce are more likely to represent the public interest in such matters.

The Institute intends to make the Australian Federal Government aware of your leading article.

A. J. Callinan,
Hon. Secretary, The Institute for the Advancement of Australian Invention and Manufacture.

154, Queen Street, Melbourne, C.A.,
June 10th, 1902.

LEGAL.

Bunce *v.* Benson & Co.

In the King's Bench Division of the High Court of Justice on Wednesday last week, before Mr. Justice Ridley and a special jury, the case of Bunce *v.* W. A. S. Benson & Co., Limited, came on for hearing. The plaintiff, Mr. Ed. George Bunce, trading as Bunce and Co., at Nottingham Street, W., sought to recover damages for alleged libel from Messrs. W. A. S. Benson & Co., electrical engineers, of 82 and 83, New Bond Street, W. In June, 1901, the plaintiff was employed as electrical engineer by a firm known as Messrs. Elliot, Son & Boyton, to do certain work in connection with the installation of the electric light at 80, Gloucester Place, W. In September the defendants wrote and published a report with respect to that work, and addressed it to a Mr. Eckersley, the tenant of the house. The report ran as follows:—"Report of existing electric wiring at 80, Gloucester Place, W. The house, which has been wired for some 75 points, or, say, 85 lights, is, we find, provided with only six double-pole fuses to protect them. This is not in conformity with the Metropolitan Company's rules, and may be objected to by them. The system of distributing employed will necessitate the use of fuses in ceiling roses and wall plugs, a not very satisfactory arrangement, and one which has been discontinued for some time by most contractors; owing to the manner in which the fuseboard has been connected up, the failure of one particular fuse would extinguish no less than 25 lights, probably putting two floors in complete darkness. There is, of course, no great harm in this, but the inconvenience caused will be readily appreciated. We certainly think that this fuseboard ought to be taken down and the wires sorted out and connected up in their proper order. We have not had time to thoroughly examine the wires. . . . The following work which we have noticed, does not satisfy the requirements of the fire insurance companies:—Wires under floors, in partitions, behind skirtings run without covering of wood casing or metal tubes, joints between wires merely twisted up and given two or three laps of tape, no solder used. Signed, W. A. S. Benson & Co., Limited. C. J. Scott, electrical manager." The plaintiff said that by the report the defendants meant that the work had been done in an inefficient and slovenly manner, and that the house in which it was done might easily take fire owing to the improper workmanship. The report, in fact, meant that the plaintiff was a negligent and incompetent workman, and that he was incapable through such negligence and incompetency of properly doing the work he had undertaken to do. It also meant, plaintiff said, that the work done by him had been done in an improper and careless and negligent manner, and that his professional services as an electrical engineer were of little or no value. He alleged that he had by the report been greatly injured in his credit and reputation as an electrical engineer, and he claimed damages. The defendants denied that the report bore the meaning alleged, and they did not admit that it was libellous of the plaintiff. They also said it was true in substance and in fact.

Mr. R. A. McCall, K.C., and Mr. Clarke Hall were counsel for the plaintiff; and Mr. Eldon Bankes, K.C., and Mr. Boxdell Houghton for the defendants.

Mr. McCall, in opening the case, said that the plaintiff had had a large experience since he commenced practice as an electrical engineer in 1897, and he had done a large amount of business with the well known firm of house agents, Messrs. Elliot, Son & Boyton. These people had through their hands in the course of every year a large number of houses, and when it was necessary to put in electric fittings they had employed the plaintiff to do it. In May or June of last year they employed him to fit up a house with wires—No. 80, Gloucester Place, W.—and plaintiff gave his estimate; his estimate was accepted and plaintiff did the work. The house was wired, and it was left to the incoming tenant to put in the necessary fittings. The incoming tenant was a Mr. Eckersley, and he instructed the defendants to put the fittings on the wires which had been already laid. Defendants sent their man, who made a cursory examination, and on the strength of that made the report complained of on the nature of the work done by the plaintiff. That report, the plaintiff said, was not only impertinent but untrue, and reflected seriously upon the plaintiff's reputation.

Mr. Edw. Geo. Bunce, examined, said he was the plaintiff, and an electrical engineer. The defendants were also well-known electrical engineers. For the past five years he was constantly doing business with Messrs. Elliot & Co. Last year he received a letter from them asking for an estimate for the wiring of the house, No. 80, Gloucester Place. He sent in an estimate, and was engaged to do the work. The wires were put in wood casing under the floors, and in steel conduits up the walls. On September 18th, when the report in question was made, the wiring was completed, but no switches were fixed over the house anywhere. At that date another fuseboard had to be fixed in the place of one which was to be taken down. Apart from these things, the rest of the work was finished. On September 19th he received a letter from Elliot & Co. enclosing a copy of the report complained of. He was not aware until he received a copy of the report that the defendants had made an inspection of the premises. He went the next day to the house with a man to take up the floor boards to see what was done. The boards on two floors had been taken up. Without removing the floor boards it was impossible for anybody to see whether the wires were cased or not. The skirtings had not been removed. He did not find that any of the wires under the floors or behind the skirtings, or up the walls, had been altered in any way. The wires left by him had been passed by the Metropolitan Electric Supply Company. Messrs. Elliot had paid him for the work. On November 19th he had an interview with Mr. Scott, representing the defendants, at his solicitor's office. His solicitor explained to Mr. Scott the serious nature of the libel, and asked him to go home and write a letter to Messrs. Elliot and Mr. Eckersley, saying there was no foundation for the report, when there would be an end of the case. His solicitor said the defendants would have to pay his fees of about £3 3s. Mr. Scott promised to go and write the letter, but demurred as to paying the costs. So far as he knew, no such letter was written, and there had been no apology.

Cross-examined by Mr. Bankes: He kept at the work from May till July. On July 5th the wiring was substantially finished. On July 11th his man put in a six-circuit distributing board. Between August 2nd and September 20th, none of his men were in the house at all. There was nothing in the house to indicate who had wired it. The witness admitted that the distributing board he first put in was wrong, and after the report he put in another—an eight-circuit board. The wrong board was put up by the fault of a clerk. He told Messrs. Elliot in a letter that he had not completed his contract when defendants went to the house, and he had not. It was quite true that defendants, directly they heard that the work was not finished, sent to Messrs. Elliot's, and said that as the plaintiff had not finished the work, he had better do so, and not they, and that they would withdraw their report. He did not complain of that, but of the statement that the joints had not been properly soldered. All the joints were properly soldered.

The hearing was adjourned.

On Thursday last week Mr. McCall stated that he was glad to say his Lordship and the jury would not be further troubled with the case. He and his learned friend, Mr. Eldon Bankes, had agreed

that the record should be withdrawn, and that the plaintiff should pay to the defendants half of their taxed costs of the action on the defendants' statement that the plaintiff was not personally to blame for any of the defects that existed. On the plaintiff's behalf he (Mr. McCall) admitted that the defendants were employed to make a report on the work, and that they were justified in stating what they did on the facts then existing in this house.

Mr. Eldon Bankes, on behalf of the defendants, said his clients did not wish to be hard on Mr. Bunce. They were willing to allow the record to be withdrawn on the terms stated.

His Lordship remarked that nothing had been said against the plaintiff personally by the defendants, and he did not think there ever was. That was his own opinion.

Mr. McCall: I am glad to hear your Lordship say so.

The Leamington and Warwick Electrical Company, Limited.

In the Chancery Division on Saturday, before Mr. Justice Farwell, Mr. Bramwell Lewis, K.C., appeared in support of a petition asking the sanction of the Court to resolutions which had been passed enabling the company to enlarge its memorandum of association. The company was incorporated in 1880 under the name of the Leamington Tramways and Omnibus Company, with a capital of £25,000. The trams were worked by horse-power, but the company had now changed its name, and it was proposed to substitute electric traction, and also to supply the town of Warwick with electric power and light and with a telephonic service. There was no opposition to the petition, and his Lordship gave his sanction as asked.

The Bournemouth Corporation Tramways.

In the Court of Appeal on Tuesday, before Lords Justices Vaughan-Williams, Romer and Stirling, the case of the Attorney-General and the Poole and District Electric Traction Company *v.* The Mayor and Corporation of Bournemouth, was heard an appeal by the plaintiffs from an order of Mr. Justice Swinfen Eady dismissing an action which had been brought to restrain the defendants from proceeding with tramway construction within the borough of Bournemouth, on the ground that no substantial commencement had been made with the works within the time specified in the Bournemouth Corporation Tramways Order. The point taken in the Court below, was that there had been no commencement with the actual laying of the tramlines, and his Lordship held that that would be too narrow a construction to place upon the word "works," and that sufficient had been done to save the rights of the Corporation. From that decision the plantiffs now appealed.

Mr. Warmington, K.C., and Mr. R. J. Parker appeared in support of the appeal, which was opposed by Mr. Vernon Smith, K.C, and Mr. C. Church were for the respondents.

Mr. Warmington in opening, contended that what the defendants had done did not comply with the requirements of the provisional order. They had obtained tenders for the construction of plant, and had entered into certain contracts for dynamos and carriages, but there had been no actual construction of works. The Act provided that if the works were not completed within two years of obtaining their powers, not commenced within one year, or commenced, but the work suspended without reasonable cause, the powers given them should cease to be exercised unless an extension of time was granted by the Board of Trade. No such extension of time had been granted, though an application had been made for an extension of time in which to complete the works. This application for longer time to complete, in no way affected the obligations of the plaintiffs as to time in which the works were to be commenced. The learned counsel proceeded to deal with the Acts of Parliament at some length, and submitted that the learned Judge in the Court below was wrong in holding that anything the plaintiffs had done amounted to a substantial commencement of the works.

Mr. Parker followed on the same side.

Mr. Vernon Smith, K.C., for the respondents, said that this was not a ratepayer's action, but really an action between two rival tramway companies. The Corporation had power up to August of this year to complete their line, and at the end of that time the Poole Company would have power to step in.

Lord Justice Vaughan-Williams asked if any application had been made to the Board of Trade for an extension of time.

Mr. Vernon Smith said that while this action was pending an application was made, and the Board of Trade had agreed to extend the time for completion of all the tramways, with the exception of the one which was now chiefly concerned. As litigation was pending with regard to this section nothing was said. The action, however, related really to all the Corporation tramways, so that if this action was successful, all their tramways must go. The Corporation could not do the work themselves, but they had given instructions that it should be done.

Lord Justice Romer said that a person who was ordered to do work did not comply with that order by simply telling his servants to do it.

Mr. Vernon Smith said that if he was not in a position to do the work, and he ordered some one else to do it, he showed at all events an intention to comply with the order. He should submit that in the present case there had been a substantial commencement of work, and that Mr. Justice Swinfen Eady had arrived at a right conclusion in dismissing the action.

Mr. Church followed on the same side.

Mr. Parker replied on behalf of the appellants.

Lord Justice Vaughan-Williams, in giving judgment, said he was of opinion that the appeal ought to be allowed. The point they had to consider was one of importance, but it did not seem to him that it raised any very great difficulty. They were asked to say whether what had been done by the Corporation in connection with their tramway scheme up to the time fixed by the provisional order for the commencement of the "works" did, or did not, in fact, amount to such commencement of the works. A good deal had been said on behalf of the appellants in support of the contention that substantial progress had been made, but he was unable to arrive at any such conclusion. He was of opinion that when the time fixed by the order had expired nothing which would save the rights of the Corporation had been done, and that therefore their powers under the order ceased. There had been no prolongation of the time fixed for the commencement of the works; true, an application had been made to the Board of Trade for an extension of the time for completion, but that was quite another matter, and such an application was based upon the hypothesis that the time for commencement had been observed. If Mr. Justice Swinfen Eady's decision could not be supported, it seemed to him that the order of the Board of Trade extending the time for completion would go for nothing, because that order did not in any way affect the non-commencement within the time specified. Under the circumstances, he was sorry to say he saw nothing for it but to reverse the decision of the Court below upon the ground that it was plain, upon the evidence, that there had been no substantial commencement within the time mentioned. He would have been very glad if there was a way in which this could be put right by the Board of Trade, for the Bournemouth Corporation were in the position of knowing what were the wants of Bournemouth, and he was afraid also they had spent a considerable sum of money, or rendered themselves liable to pay a considerable sum of money, with respect of the contracts they had entered into. Under the circumstances, one would be glad to afford the Corporation an opportunity to get the Board of Trade to do something to obviate this unfortunate result, though at the same time he did not see what could be done. He was afraid that this appeal must be allowed, and he was afraid also that the order for an injunction would have to go.

Lord Justice Romer agreed that the appeal, if successful, would inflict great hardship upon the defendants, but clearly that Court could not allow considerations of that kind to affect its judgment. In construing the Act of Parliament it should be borne in mind that the provision as to time which they had to enforce was a provision which, in the interests of the public, ought fairly and properly construed to be strictly enforced, even though the enforcement resulted in individual injury being inflicted. He agreed that in this case there had not been any substantial commencement of the works within the time specified, and that the appeal ought to be allowed with costs.

Lord Justice Stirling concurred, and the appeal was therefore allowed, with costs.

The British Pioneer Electric Light and Power Company of India, Limited, *v.* Bigham.

In the Chancery Division of the High Court of Justice on Thursday the hearing of this action came before Mr. Justice Byrne.

Mr. Levett, K.C., who appeared for the plaintiffs, said this was an action in which the plaintiff company sought to have it declared that the defendant was a trustee for them of a certain concession, the object of which was to electrify the tramways of Bombay. The plaintiffs also sought to restrain him from revoking an irrevocable power he gave to them in respect of this concession, the plaintiffs' point being that the concession was obtained by the defendant as their paid agent, on their behalf. That was in substance the action. There was a counterclaim arising on the construction of the agreement under which the defendant became plaintiffs' servant. The agreement was really made by telegram, and his Lordship would have to construe certain telegrams which passed between the parties. The first point was whether, as part of his remuneration for the service of obtaining a concession for the plaintiffs, the defendant was entitled to subscribe for 200 shares in the plaintiff company. That was very important. The concession having been obtained, had practically been resold at a large profit, and the shares of the company were worth seven or eight times their nominal value. The second point was what the defendant was entitled to in the way of expenses; but that might be a matter of inquiry.

Mr. Norton, K.C., who appeared for the defendant, said he did not say his client was not trustee of the concession for the plaintiffs; he obtained the concession for them; but he did say he was not bound to give the plaintiffs a power of attorney.

Mr. Levett, K.C., continuing, said the plaintiff company was incorporated in February, 1899, with a capital of £3,000 divided into £1 shares. The company was one of three similar companies with similar objects, the other two being for China and Japan. The idea was with this small capital to get a concession and then to sell to a larger company to be formed to work it, and behind this there were two large companies, one called the Brush Electrical Engineering Company, and the other the Electric Traction Company. The learned counsel then went on to say that the defendant, being in the service of the plaintiffs, was returning from Adelaide when plaintiffs heard there was a chance of getting a concession for the Bombay traffic. The telegram reached the defendant at Colombo on his way home, and from there he went to Bombay, obtained the concession and then came home.

In the result, his Lordship held that the defendant was entitled to £400 from the plaintiffs, subject to an account showing what was due, and the 200 shares in the company and the expenses properly

incurred as agent for the plaintiffs (not being his personal and travelling expenses) for obtaining the concession. His Lordship made a declaration that the defendant was trustee for the plaintiffs, and the defendant was not to have the right to apply for further shares. His Lordship granted a limited injunction restraining defendant from interfering with the disposal or carrying out of the concession except as trustee and agent for the plaintiffs. His Lordship said that the defendant had no right to superintend, or claim to superintend, the carrying out of the Bombay contract. He directed that there should be no costs on either side.

Maxwell v. Hartlepool Tramways Company, Limited.

At Durham Assizes, Mr. Justice Bruce heard an action in which a cyclist, named Maxwell, sued the Hartlepool Tramways Company, Limited, for damages for personal injury. Whilst he was out riding, the trolley pole rope of a tram caught him by the neck. He was thrown off his machine, which was smashed, and his injuries kept him from business for a long time. Whilst admitting liability, defendants' counsel urged that the extent of plaintiff's injuries had been greatly exaggerated. Judgment was entered for plaintiff for £250, without costs.

Dudley, Stourbridge and District Electric Traction Company.

The Dudley Bench, on July 12th, had before them three cases in which the above company were summoned for having no speed indicators on their cars, two summonses under the bye-laws for failing to exhibit the Board of Trade regulations on the cars, and two summonses for carrying passengers on the roof of cars on the Pensnett Light Railway.

For the defence it was urged that the failure to post the regulations was due to the negligence of the car cleaners; that there was no apparatus of the kind required in existence so that the company could provide speed indicators, and that while the Light Railways Order by one clause prohibited double-decked carriages, it specified in another what precautions should be taken for the protection of passengers on the top of such cars.

On the first three summonses the defendants were fined 2s. 6d. and costs in each case; and for the breaches of the Light Railways Order, 20s. and costs in each case. The charges of failing to supply speed indicators, were adjourned *sine die*.

PARLIAMENTARY.

Mexborough and Swinton Tramways.—On Monday the Court of References in the House of Commons considered the petition of the Rotherham Corporation to be heard by counsel against the Mexborough and Swinton Tramways Bill.—Mr. Honoratus Lloyd said that in 1900 two competitive Bills were promoted, one by the Rotherham Corporation, and the other by the Rawmarsh Urban District Council, to construct a through route between the two places. By an agreement each party was to construct its own tramways to the boundary, and thus Rotherham would construct their trams over three-fourths of the length of Rawmarsh Bridge, and Rawmarsh would construct theirs over one-fourth of the bridge, so as to join with the Rotherham tramways, and complete the route. The bridge was to be rebuilt at a cost of £12,000, Rotherham paying £9,000 as the cost of their three-fourths. Under the present Bill Mexborough were able to take over the powers of the Rawmarsh Council, and the clause enabling the Corporation to agree upon running powers having been struck out in the other House, the Corporation of Rotherham would have to spend £9,000 without obtaining the desired through route. They therefore desired to appear before the Select Committee, to which the Bill was remitted, and argue that if they spent this £9,000, they should be empowered to make new agreements with the new company.—Mr. Wedderburn, K.C., on behalf of the promoters, said that, although under the Bill as brought in the Corporation had a power to agree, no agreements had really been arrived at, and the Corporation had no vested rights. Nevertheless, he was willing that the Corporation should have a clause giving them the power to agree. It was agreed by the Court to grant a *locus standi* to the Corporation in respect of the clause which affected them, as to the extent of the powers to be given to the Corporation to agree with the Mexborough Company.

On Tuesday the Bill came before a Select Committee of the House of Commons, presided over by Mr. Ashton. Mr. Wedderburn, K.C., and Mr. Waugh appeared for the promoters. The clauses having been adjusted, the Bill was ordered to be reported.

Rhondda Valley Tramways.—The Committee resumed its consideration of this Bill on Wednesday last week. The Bill was ordered to be reported to the House for third reading.

Tramway Orders Confirmation Bill, No. 2.—The Lancashire and Yorkshire Railway Company have petitioned against the confirmation of the order to the West Riding Tramways (Knottingley Extension) contained in this Bill.

North Staffordshire Tramways Bill.—This Bill came before a Select Committee of the House of Commons, presided over by Mr. Ashton, M.P., on Thursday last week. It was announced, however, that all opposition had been withdrawn, and consequently the Bill was referred to the Committee on Unopposed Bills. Under the Bill further powers are conferred on the Potteries Electric Traction Company, Limited, with regard to these tramways.

Metropolitan District Railway Bill.—The Metropolitan District Railway Bill, which empowers the company to lay down and maintain substituted mains for electrical energy, and to work certain railways by electrical energy, &c., came before a Select Committee of the House of Lords, presided over by Mr. Rosse, on Wednesday last week.—Mr. Pember, K.C., on behalf of the promoters, explained the objects of the Bill, and stated that a site for a generating station had been acquired at Lots Road, Chelsea, and the work of erecting the necessary buildings was rapidly proceeding. In the last session of Parliament a Bill was passed which enabled the company to carry their mains through certain streets, but as it was now found that certain important sewers of the London County Council were carried down several of the streets, the company wished to substitute other routes for those which were in the Bill of last year. In the House of Commons opposition was offered by the Kensington Council and the Chelsea Council, but these objections were overruled. The only opposition now came from the London County Council, who put forward certain conditions, which generally the company had accepted, and now it was wished that these acceptances should be publicly stated.—Mr. Perks, M.P., the chairman of the company, was called, and examined by M. Freeman on behalf of the London County Council. He stated that the company had no objection to submitting their plans to the Board of Trade, and were willing not to interfere with the access to the Council's property which adjoined the Lots Road generating station. They were willing to accept clauses to carry out these conditions, and also with regard to the depth at which the mains should be laid, so as not to interfere with the Council's sewers.—The Committee passed the preamble of the Bill, and ordered the necessary clauses to be inserted.

Birmingham and Midland Tramways.—This Bill, which authorises the company to construct additional tramways in the districts of Handsworth, Smethwick, Oldbury and Rowley Regis, came before the Chairman of Ways and Means in the House of Commons on Thursday last week as an unopposed measure. The preamble was proved and the Bill ordered to go forward for third reading. The Bill has already passed the House of Lords.

Central London Railway Bill.—The amended Bill of the Central London Railway Company came before the Chairman of Ways and Means in the House of Commons on Thursday last week, and being unopposed was ordered to be reported for third reading. It will be remembered that the Bill originally sought power to enable the company to construct a line from Shepherd's Bush to Liverpool Street, besides the acquisition of additional land at the Marble Arch, and the raising of further capital. The major portion of the scheme for the construction of the new line was rejected by Lord Windsor's Tube Committee, and consequently these portions have been struck out of the Bill.

Metropolitan Railway.—On Tuesday the Metropolitan Railway Bill came before Earl Morley's Committee of the House of Lords on unopposed Bills, and was ordered to go forward. The Bill authorises the company to execute further work and acquire lands for generating electricity, &c.

Croydon and District Electric Tramways Bill came before the Unopposed Committee of the House of Lords, presided over by Earl Morley on Tuesday. There being no opposition, the Bill was ordered to be reported to the House. The Bill authorises the British Electric Traction Company, Limited, to construct tramways in the counties of London, Surrey and Kent.

BUSINESS NOTES.

Dialite.—The St. Helens Cable Company have received orders for their "Dialite" bitumen cable from Maidstone and Nuneaton.

The Fans at Buckingham Palace.—Acting upon instructions received from Buckingham Palace, a number of "Veritys' Lundell" pedestal fans English-made fans were supplied at short notice for the use of H.M. King Edward VII., Queen Alexandra and Royal visitors at the Palace at the commencement of the recent hot summer weather. As the daily papers mention, the King's health and comfort were greatly assisted by the extra ventilation in the Royal chamber thus afforded.

Electrical Works at Manchester.—The Schuckert Company's representatives are stated to have been looking over sites in Trafford Park District with a view to establishing works there.

The Manchester correspondent of the *Financier* says that it is expected that the huge works there of the British Westinghouse Company will be completed about the beginning of September. It is intended to inaugurate the working by a banquet, at which Mr. Westinghouse and a leading American steel king are expected to be present.

Sentence.—Two men, A. Bigmore and A. Lloyd, have been sentenced to 9 and 12 months' hard labour respectively for stealing and receiving gutta-percha from the Telegraph Construction Company.

Sweden.—A company has just been formed in Stockholm, with a capital of 35,000 kr., to be known as the Elektriska Industriaktiebolag Stella.

Electrical Wares Exported.

WEEK ENDING JULY 16TH, 1901.		WEEK ENDING JULY 15TH, 1902.	
Adelaide. Teleph. mat.	Value £85	Alexandria	Value £393
Alexandria	63	Azores	200
Amsterdam	80	,, Teleg. instruments	190
Boca. Teleg. mat.	265	Boulogne	15
,, Teleg. mat.	223	Buenos Ayres. Teleg. mat.	128
Bombay	50	,, Teleg. wire	611
Boulogne	100	Calcutia	391
Brisbane. Teleg. cable	114	Cape Town	831
,, Teleg. instruments	350	,, Teleg. mat.	317
,, Teleg. stores	83	Channel Islands	63
Buenos Ayres	642	Christchurch	61
,, Teleg. cable	800	Colombo	396
Calcutia	856	Durban	830
,, Teleg. wire	100	,, Teleg. mat.	132
Cape Town	973	East London	1,982
Christiania. Teleg. wire	96	Gibraltar	50
Colombo	667	Gothenburg. Telephone	444
Copenhagen. Teleg. wire	93	Hamburg. Teleg. mat.	531
Durban	483	Hong Kong	10
,, Teleg. mat.	96	Melbourne	113
East London. Teleg. sundries	206	New York	140
Gothenburg	19	Port Elizabeth	88
Hamburg. Teleg. mat.	550	St. Petersburg. Teleg. wire	1,162
Hong Kong	74	Shanghai	47
Kobe. Teleph. apparatus	335	Singapore. Teleg. mat.	209
Launceston	128	Stockholm. Teleph. cable	455
Lyttleton	115	Sydney	1,274
Malta	1,000		
Maryborough. Teleg. mat.	1,161	Total	£10,297
Mazagan	812		
Melbourne	10		
,, Teleg. wire	175		
Napier	12		
Paysandu	800		
Perth	770		
St. Petersburg. Teleg. mat.	50		
Saigon	19		
Stockholm. Teleg. mat.	87		
Sydney	671		
,, Teleg. cable	307		
Townsville. Teleg. mat.	848		
Yokohama	420		
Total	£14,039		

Foreign Goods Transhipped.

Cape Town. Elec. mat.	Value	£260
Colombo. Elec. lighting mat.		28
Durban. Elec. mat.		40
Hamburg. Elec. goods.		20
Total		£343

Bankruptcy Proceedings.—At a meeting of the creditors of David Roberts, electrical engineer, 30, Machlin Street, Derby, on Friday, it was stated that the unsecured liabilities amounted to £139 10s. 7d., and the deficiency to £111 18s. 1d. Loss of law suit, and loss of credit and trade from the same cause, experimenting on motors, and want of capital, are the causes of failure.

In *re* A. Pollock, electrical engineer, Middlesbrough, first meeting and public examination are to be held July 25th.

Dissolutions and Liquidations.—The Hiram Maxim Lamp Company is winding up voluntarily, with W. F. Mills, 37, Walbrook, E.C., as liquidator.

Books Received.—"Supplementary Regulations for Secondary Day Schools and for Evening Schools" (from August 1st, 1902 to July 31st, 1903). London: Board of Education and Eyre and Spottiswoode. 1902. 4d.

"Fortschritte der Elektrotechnik," by Dr. Karl Strecker. 1900, fourth part. Berlin: Julius Springer. 1902.

"The Steam Turbine," by Robt. M. Neilson. London: Longmans, Green & Co. 1902. 7s. 6d. net.

"Die Internationalen absoluten Masse, insbesondere die Electrischen Masse," by Dr. A. von Waltenhofen. Brunswick: Vieweg and Sohn. 8 and 9 marks.

Catalogues and Lists.—MESSRS. P. R. JACKSON & CO., LTD., of Salford Rolling Mills, Manchester, have issued a new price list of their enclosed ventilated motors.

The MIDLAND ELECTRIC WIRE CO., of Leicester, have brought out a new list, giving prices and particulars in tabulated form of their electric light wires and cables, dynamo wires, flex cords, &c.

MESSRS. NALDER BROS. & THOMPSON, LTD., have sent us a copy of Section 2 of their new catalogue treating of permanent magnet ammeters and voltmeters manufactured by them. The list is fully illustrated and gives prices. The company will shortly be bringing out Section 3 of the catalogue, which treats of recording instruments; also Section 4, which will cover their line of automatic switches and circuit breakers.

MESSRS. MONTE CALLOW & Co., of Ludgate Broadway, E.C., have placed before us a copy of the "Polyphase" section of their catalogue of "Perfecta" resistance apparatus, detailing starters, regulators and controllers.

MESSRS. DAVIES BROS. & Co., LTD., of Crown Works, Wolverhampton, have sent us a list of galvanised corrugated sheets and fittings for sheds, roofings, tanks, &c.

The G.E. Co. have issued a handy little pocket booklet of 24 pp., in which they give some tables of the electric lighting stations in the United Kingdom, for which details they acknowledge the permission of the proprietors of the ELECTRICAL REVIEW. Alternate pages give particulars of G.E.C. special lines of manufacture.

MESSRS. ERNEST SCOTT & MOUNTAIN, LTD., have prepared a beautifully set out brochure—"Machinery for electric power transmission," in which many illustrations and particulars are given of the latest types of machinery supplied by them for such work in mines, collieries, factories, &c.

MESSRS. LASSEN & HJORT, of Queen Victoria Street, E.C., have sent us one of their lists of the Atlas superheated steam engine. They work under the Schmidt patents by arrangement with Messrs. Easton.

MR. T. W. WARD, of Albion Works, Savile Street, Sheffield, who has recently opened extensive new machinery showrooms, has issued a list of new machinery which he has to offer, including engineers' tools, dynamos, motors, pumps, boilers, &c.

An illustrated sheet of different types of electric ventilating fans and motors has come to hand from MR. G. WEHR SÖHNE, of Berlin.

Electric Launch. — Messrs. Veritys, Limited, have received instructions direct from His Highness The Maharajah Sir Ganga Singh of Bikaner, to build and equip an electric launch suitable for sporting purposes. It will have a specially shallow draught, and be constructed in such a manner that weeds will be incapable of obstructing its progress. We learn that this order resulted from the firm having satisfactorily supplied His Highness with all the requisite fittings for his palace at Bikaner, and afterwards with the necessary plant and material for a small central station and lighting scheme in his State.

Electrical Exhibition at Falmouth.—The sixty-eighth exhibition of the Royal Cornwall Polytechnic Society will be opened at Falmouth on Tuesday, August 26th, and, as announced in our advertisement pages to-day, there is to be a special feature made of electrical appliances. This is partly because the present president is Sir W. H. Preece, K.C.B., F.R.S. The Exhibition will remain open until August 30th, and exhibits are invited under the following sections:—

1. Electrical generating plants suitable for central supply stations or for isolated lighting or motor installations with oil, petrol, gas or steam engines.
2. Lighting accessories, lamps, fittings, wires, &c.
3. Motors and motor-driven machinery.
4. Electric traction apparatus.
5. Electric bell apparatus.
6. Telegraph and telephone apparatus for Post Office, domestic, and railway work.
7. Wireless telegraph apparatus.
8. Submarine cable apparatus.
9. Electric motor cars and electrical accessories for automobile work.

(Current will be provided by arrangement.)

Recognising the importance of adopting modern methods and machinery, especially for the use of mining, the Royal Cornwall Polytechnic Society invite manufacturers and engineers to exhibit:—

(1) Motor fans, pumps, and winches; (2) electric rock drills; (3) underground traction; (4) wiring systems for damp situations; (5) signalling and telephone apparatus.

Imports of Foreign Electrical Plant.—June proved to be rather an active month as regards the imports of foreign electrical goods and apparatus into this country. The value of the imports during the month amounted to £71,709 as compared with £5,336 in the previous month and £54,307 in June last year. So far as the year has gone, however, there has been a notable decrease in these imports, the returns for the six months ending with June last showed a total of only £355,411 as compared with £552,966 in the corresponding six months of 1901.

Not Guilty.—Before the Common Sergeant at the Old Bailey on 9th inst., Charles Bright, J. F. Moreno, and R. G. Fudge, were brought up on a charge of concealing shares with a view to defrauding creditors. The case was frequently referred to in our columns during the hearing in the City. The finding of the jury at the Old Bailey was that no case had been made out against the defendants. The Common Sergeant said that the bankruptcy proceedings against Bright were misconceived. All the defendants were found "Not Guilty."

Trade Announcements.—The American Circular Loom Company, of Boston, has opened offices at 27, Chancery Lane, London, E.C., for introducing its flexible loom conduit in this country. The product is claimed to possess many advantages for interior wiring, and it is stated that in America alone 15,000,000 ft. was used last year. Illustrated catalogues and price lists may be obtained at the above address. The flexibility of the conduit allows of bends of any radius at the will of the constructor. The tube is constructed of a spiral of the best insulating fibre, wound with a heavy Para rubber friction tape, over which is a continuous woven jacket of cotton, similar to that in use in the ordinary garden hose, except that the stitch is much finer, giving it the quality of strong canvas. The whole tube is then saturated with an insulating compound, care being taken that none shall touch the inside fibre, thus leaving the inside of the tube smooth and hard. It is finally run through powdered mica, thus producing a tube which is thoroughly flexible and waterproof, and highly fireproof. Mr. J. H. Cummings is the European agent for the American company.

Mr. H. E. McKrell has just been appointed manager for London to the Anchor Cable Co., Ltd., of Dacre House, Victoria Street, S.W. A stock of standard sizes will be kept in London.

The business of Messrs. Hugo Gibson & Co., electric light and power contractors and engineers, of 14, Temple Street, Birmingham, will in future be carried on alone by Mr. Arthur Hugo Cecil Gibson, the other partners, Mr. Ernest Geo. Miles and Ada Gibson having retired.

The Newton Electrical Works, Ltd., of Taunton, have purchased

the gas and oil engine business lately carried on by Messrs. Allen and Barker, of Taunton. They have now special facilities for manufacturing the engines on a larger scale than heretofore, and have secured the services of Mr. Barker, and a portion of the old staff and hands, so that the business will, therefore, proceed uninterruptedly, and on a larger scale.

ELECTRIC LIGHT AND POWER NOTES.

Abersychan.—The Council has received notice from the Provincial Electric Supply and Traction Co., Ltd., that they intend applying for a prov. order to supply electrical energy in the district. The Council has decided to object to the application and to apply for a prov. order itself.

Ashton-under-Lyne.—The following rates for the supply of energy have been adopted by the T.C.:—Public lighting, 2½d. per unit; other Corporation departments, 3½d.; private consumers, 4d., or alternatively 1s. per 8-c.p. lamp fixed per quarter, and in addition 1½d. per unit; for power purposes, 1½d.

Asylum.—The Fife and Kinross Asylum Board has resolved to adopt electric lighting.

Bangor (Wales).—The electric light works are about to be enlarged, owing to the increased consumption. Mr. Pryce Smith is the manager.

Barnes and Mortlake.—Application has been made by the U.D.C. for a further loan of £1,900 for house connections. About 250 connections are on order.

Beverley.—The L.G.B. has sanctioned the borrowing of £14,784 for electric lighting purposes.

Birkdale.—On August 1st the electric power station will be inaugurated. The cost of the undertaking is estimated at £30,000.

Bognor.—An Electric Light and Power Company intends to make application for a prov. order to supply electricity within the district.

Bradford.—Bradford enjoyed its peace and thanksgiving celebrations last Monday, and an unprecedented use of electric lighting was made for the purpose. The two most notable features of the illuminations were put down to the credit of the Electrical and Tramway Departments. Mr. Chattock, the city electrical engineer, had designed pictorial representations in coloured lights of typical animals of the Colonies and India, which occupied the whole of one end of the Town Hall, and attracted unstinted admiration. The chief success, however, was an electric tramcar, the framework of which was completely hidden under a mass of 800 coloured lamps, made up in elaborate designs, and constituting, by general admission, the prettiest thing ever seen in the city in the way of illuminations. The car traversed the whole of the Bradford routes during the evening.

Brentford.—The U.D.C. has received notices of application for electric lighting powers from the United Electric Light Company, Limited, and the Provincial Electric Light Company. It has decided to oppose both schemes.

Brentwood.—The Provincial Electric Supply and Traction Company intends to apply for a prov. order to supply electric light in the district.

Bridgwater.—The Bridgwater District Electric Supply and Traction Company, Limited, is applying to the B. of T. for a prov. order to supply the area of the borough and part of the rural district.

Brierfield.—At the meeting of the U.D.C. on July 10th a letter was read from the town clerk of Nelson, intimating the willingness of the Corporation to supply electricity to Brierfield for illuminating purposes at 2d. per unit.

Bristol.—The statement of accounts of the Corporation electrical undertaking for the year ended March 31st last, shows that the number of consumers on March 25th, 1902, was 1,790, being an increase of 283 during the year. The total connections to the mains are equivalent to 149,146 8-c.p. lamps, this being an aggregate increase equivalent to 29,531 lamps. The number of units sold was—private lighting 1,965,794, power 310,054, public lighting 480,776, making a total of 2,756,624, and an aggregate increase of 565,065. The use of electric motive power has continued to increase, and the sale of energy for that purpose has more than doubled during the year. The gross receipts amounted to £44,882 12s. 3d., and the gross expenditure to £26,848 7s. 11d., leaving a gross profit of £18,034 4s. 4d., to meet capital charges of £19,030 5s. 5d. The credit balance at the commencement of the year was £505 3s. 7d., which, with £490 17s. 6d. transferred from the reserve fund, has met the deficiency on the year's working of £996 1s. 1d. A report from the City electrical engineer shows that the total number of sub-stations now constructed is 55, and the total mileage of cables laid is 159, having 550 miles of conductors. The cost of working the undertaking has been considerably reduced. Although the very heavy expenses in connection with charges on capital, amounting to considerably over 1½d. per unit sold, much of which capital has not even yet become remunerative, have prevented the securing of a net profit, Mr. Faraday Proctor estimates that the working of the department during the next financial year will enable a further sum to be placed to the credit of the reserve. The demand for electricity for power purposes showed an exceedingly satisfactory development, and many of the larger firms in the city are now taking, or arranging to take, electricity from the department for driving their machinery.

Bromley.—Messrs. Edmundson's Electricity Corporation have notified the R.D.C. that they have applied to the B. of T. for a prov. order for supplying Farnborough, Hayes, Keston, Orpington and St. Mary Cray.

Burslem.—The Potteries Electric Traction Co. have informed the T.C. of their intention to apply to the B. of T. for a provisional order to supply electricity in the Council's area.

Calverley.—The Provincial Electric Supply and Traction Co. intend to apply for a prov. order for the supply of electrical energy within the district. The U.D.C. has decided to oppose the application, and to take steps to apply for an order.

Carnarvon.—Sir Wm. Preece, on Saturday, addressed at Carnarvon a meeting of the representatives of various public bodies in the county, at which he urged the necessity for carrying into effect a scheme for a uniform service of electricity, which he pointed out could be worked out at a comparatively small cost, seeing the large amount of water power available. A committee was appointed to enter into the details.

Sir Wm. Preece estimated that at least 20,000 H.P. was in use in the county. If Llandudno, Conway, Bangor, Carnarvon, Pwlheli, and Criccieth amalgamated together to generate their own electrical energy, they would save a third of their capital, and get their electricity at a third of the price. He considered that three power stations would be required for the county, one of which could be operated by water.

Castleford.—The U.D.C. has received from the Provincial Electric Supply and Traction Co. notice of its intention to apply for a prov. order to supply in the Council's district.

Clacton-on-Sea.—The B. of T. has agreed to postpone any decision with reference to the revocation of the U.D.C.'s electric lighting order, until January next.

Deptford.—The M.B.C. has received notice from Mr. Sydney Morse on account of the County of London and Brush Provincial E.L. Co., that he will apply for a prov. order for Deptford.

Drayton.—An application on behalf of the Market Drayton Electric Light and Power Company, for the consent of the Council to an application by the company for a prov. order authorising the company to supply electricity in the parish of Drayton-in-Hales, has been granted by the R.D.C.

Durban.—At a meeting of the Town Council on June 23rd it was decided to send an indent to England for a further £25,000 worth of electrical machinery, so as to overtake the extraordinary demand for electric light. It is also proposed to import electric cars for the use of coloured people, to be labelled "Not for Europeans."

Dewsbury.—The T.C. has decided to obtain the sanction of the L.G.B. to the borrowing of £10,000 for further extensions of the electricity works, necessitated by the supply of energy to the British Electric Traction Company.

Earleston.—The Provincial Electric Supply and Traction Company intends to apply for authority to supply electricity in the Newton-in-Makerfield district.

Eccles.—The T.C. has applied to the L.G.B. for permission to raise a loan of £22,815, for the extension of the electric lighting scheme.

Failsworth.—The U.D.C. has decided to transfer its prov. order for electricity supply to the Corporation of Manchester for a term of 21 years, subject to the approval of the Board of Trade.

Faversham.—The South-Eastern Electric Lighting Company is about to apply for a prov. order to supply electricity within the R.D. Council's area.

Finchley.—The B. of T. has decided to defer consideration of the question of revoking the Council's prov. order for another year.

Frome.—The U.D.C. has decided that application be made to the L.G.B. to sanction the borrowing by the Council of such sum as may be necessary for the installation of works for the supply of electricity within the district, and that Mr. F. H. Medhurst be engaged as consulting engineer of the Council.

Gwyrfai.—The D.C. has decided to support the application of Mr. Assheton Smith, the owner of the Dinorwic Slate

Quarries, for a prov. order to light the rural districts between the quarries and the sea at Port Dinorwic with electricity.

Hawick.—The T.C. has decided to light all the streets of the town with electric light instead of gas. The electric company's offer for lighting, upkeep, extinguishing, &c., is over £1,070 per annum, while the gas company's offer was £844.

Heston—Isleworth.—The U.D.C. has received notice from the United Electric Lighting Co. of their intention to apply for electric lighting powers. The Council has decided to oppose the application, and having considered the report of Mr. Enright on a scheme to light the district, has resolved to ask the B. of T. for an extension of time.

Inverness.—The Electric Supply Corporation, Limited, London, intend to apply for a prov. order to erect electric lighting works in the burgh. The petition will be opposed by the T.C.

Isle of Wight.—For the twofold purpose of supplying the district at Parkhurst and Cowes from Newport, for which a main will have to be laid between the two towns, Edmundson's Electricity Corporation have given notice to the R.D.C. that the Isle of Wight Electric Light and Power Co. intend to apply for a prov. order for electric lighting in the parishes of Carisbrooke and Northwood.

Kent.—Messrs. Downer & Jackson have given notice to the East Ashford R.D.C. of the intention of the South-Eastern Electric Lighting Co. to apply for a prov. order to supply electricity within the company's area. Bridge R.D.C. has decided to support the same company's application to supply in the Council's area. Cranbrook District Council has received a similar intimation from the South-Eastern E.L. Co.

The Kent E.P.D. Co., Ltd., the Kent Electric Power Company and the South-Eastern Electric Lighting Company respectively intend to apply for prov. orders to supply electricity within the Eastry Council's area.

The Provincial Electric Supply and Traction Company has given notice to the Chatham T.C. of its intention to apply for a prov. order for the supply of electricity within the area of the Chatham authority. The Kent E.P.D. Co., Limited, has given the Council similar notice.

The County of Kent Electrical Power Distribution Company, Limited, intends to apply for a prov. order to supply electrical energy within the Urban District of Sittingbourne. The Kent Electric Power Company also intends to apply for a prov. order.

The South-Eastern Electric Lighting Company and the Kent Electrical Power Distribution Company intend to apply for prov. orders to supply electrical energy in Queenborough.

Rochester.—The Kent Electric Power Company, the Kent E.P.D. Co., Limited, and the Provincial Electric Supply and Traction Company, have all intimated their intention to apply for prov. orders to supply electricity within the city.

Blean.—The South-Eastern Electric Lighting Company intend to apply for a prov. order to supply electricity in the R.D.C.'s area.

Bramby.—Messrs. Edmundson's Electricity Corporation, Limited, the South-Eastern Electricity Company, the Kent E.P.D. Co., Limited, and the Kent Electric Power Company intend to apply for prov. orders for electric lighting in the R.D.C.'s district.

Milton.—The U.D.C. have received notices from the County of Kent Electrical Power Distribution Company and the Kent Electric Power Company of their intention to apply for prov. orders to enable them to supply electrical energy in the Milton district.

Kilmarnock.—The Electric Committee has offered Mr. Bryson, who was appointed engineer for a scheme of electric lighting in the burgh, a sum of £330 as a settlement in full of his claim and expenses, in consequence of the scheme having been, in the meantime, abandoned. It is stated that Mr. Bryson, whose original claim was £976 17s. 3d., has signified his willingness to accept this sum.

Leven.—The Electric Supply Corporation, London, intends to apply for a prov. order for electric lighting in the burgh.

Littlehampton.—An electrical supply company intends to apply for powers to supply electricity in the district.

Liverpool.—During the recent rejoicings the people of Liverpool were entertained by an illuminated tramcar, which was permitted by the Tramways Committee to run over the main routes in the city. The illuminations of the car were specially designed for the Coronation festivities.

London.—L.C.C.—At last week's meeting the Highways Committee reported that as the number of alternating current electricity meters sent in to be tested at the stations established for the purpose in Cranbourne Street and Victoria Embankment was very large and was constantly increasing, it was necessary in order to cope successfully and expeditiously with the work to provide additional apparatus at the Embankment station. Having regard to the desirability that no ground for complaint of unnecessary delay should exist, the Committee considered that the plant required should be obtained as soon as possible, and on their recommendation the Council authorised an expenditure of £500 for the purchase of an alternator and a motor.

The Lewisham Supply Co.—The Highways Committee recalled the fact that the Lewisham and District Electric Supply Co. some time ago carried out certain works without having first obtained the approval of the Council, and after having had notice of the Council's disapproval of the works. As a result of police-court proceedings in respect of these unauthorised works the company was fined sums amounting to £14, and was ordered to pay £10 10s. to the Council as costs. The company appealed to the Board of Trade against the Council's disapproval of the works, but withdrew the appeal at the inquiry instituted by the Board. A fresh notice had recently been served by the company in regard to those and other works, and at an interview between the officers of the Council and of the company the representatives of the latter proposed that the Council should approve the fresh notice on the company entering into an agreement that certain portions of the mains already laid should be removed, if so required by the Council, at any time within three years from the date of the agreement, by the company at its own cost, if not exceeding £200, and the Council to pay half of any cost beyond that amount. The Highways Committee were advised that this was an equitable arrangement in the circumstances, and the Council recently gave conditional approval of the works. The solicitor had since obtained from the company's solicitors written confirmation of the proposal made at the interview, and had prepared an agreement in accordance therewith. It was decided to approve the agreement, and to authorise the solicitor to obtain its completion.

The Council, on Tuesday, resolved to lend £25,000 to the Fulham Borough Council for an extension of the electric lighting installation.

Kensington.—The M.B.C. some time ago resolved to extend the public arc lighting in the main roads, and 98 new lamps have so far been put into use.

Lydd.—The South-Eastern Electric Lighting Company intends to apply for a prov. order for supplying electricity in the borough.

Melbourne.—At a meeting of the City Council on 10th ult. it was decided to obtain a loan of £50,000 for the purpose of carrying out the additional works necessary to complete the Council's electric supply scheme already authorised, and for extension of the underground mains.

Mexborough.—The U.D.C. is to make application for a loan of £2,500 for extension of the electricity undertaking.

Newport.—Mr. Parshall, consulting electrical engineer to the B.C., proposes that a new unit of 500 kw. output should be provided, making a total plant capacity of 1,500 kw., and that a secondary battery of a total storage capacity of 1,000 kw.-hours, based on a 5 hours' discharge, be installed, in order to equalise the load on the generators, and to enable the plant to be shut down at night. The estimated cost of the whole of the plant and work referred to, amounts to £17,933 11s., made up as follows:—Additions to steam generating plant, including two boilers, one 800-i.h.p. engine, one 500-kw. generator, piping, foundations, balancer, additions to switchboard and connections, £10,379 6s. 8d.; storage batteries, boosters, additions to switchboard, connections, &c., £5,580; feeders for supplying portion of lighting network, £1,974 4s. 4d. The Electricity Committee has resolved to recommend the Council to accept tenders for this plant.

Newton-le-Willows.—The U.D.C. has received from the Provincial Electric Supply Company, a notice of their intention to apply for a prov. order to supply electricity in the Council's area.

Niagara.—It is said that contracts have been let for part of the plant needed for the transmission of electric current from Niagara Falls to Toronto. The distance is 90 miles, and the transmission is to be effected at a pressure of 60,000 volts. The generating plant will consist of 10,000 h.p. units, generating current at 11,000 volts, step-up transformers being used to raise this to the line potential. It is hoped that by July next year the first of these units will be at work.

Penzance.—The Provincial Electric Supply and Traction Company and the United Electric Light and Power Company intend to apply for a prov. order to supply electricity within the area of Penzance.

Pontypridd.—It is calculated that the small generating plant will afford sufficient power to run the first tramway from this town to the big colliery centre of Cilfynydd in five months. It is quite within the range of probability that there may be a settlement of the differences between the local authorities and the South Wales Distribution Company. Negotiations are proceeding with a desire for a satisfactory adjustment.

Renfrew.—The Electric Supply Corporation intends to apply for a prov. order to supply electricity within the burgh. The T.C. will oppose the application.

Ripley.—The Provincial Electric Supply and Traction Company and the Derbyshire and Nottinghamshire Electric Power Company state their intention to apply for prov. orders for electric lighting in the district.

River Tyne.—The South Shields Corporation has in hand the lighting of the market place and direct ferry landings with electricity.

Romford.—Three companies, Messrs. J. & J. S. Enright, the Allgemeine Electric Company, and the United Electric Light and Power Supply Company, are in competition for lighting the district. The tenders have been referred to the Council's electrical engineer for his opinion.

St. Annes.—At the meeting of the U.D.C. on July 9th it was reported that instead of the profit of £12 stated to have been made at the electricity works last year there was a loss of £327, the payment of a quarter's interest and sinking fund contribution not having been included in the statement recently made.

Scunthorpe.—On the ground that it is its intention to apply for a prov. order itself, the U.D.C. has decided to oppose the application of a London company to the B. of T. for power to supply electricity within the Council's district.

Seaford.—At the U.D.C. meeting on Monday a letter was read from Mr. F. J. Warden Stevens, inquiring whether the Council would consent and offer facilities to a company proposing to supply electricity in the Council's area. It was decided to reply that if the company submitted their scheme and it met with approval, facilities would be given.

Southgate.—The U.D.C. has decided to apply for a prov. order for the generating and distributing of electricity.

Southport.—So successful have been the electric illuminations prepared in view of the Coronation, that the T.C. has decided on a permanent scheme. The whole length of Lord Street from the Prince of Wales Hotel to St. George's Church will be illuminated on one side. The estimated cost of the scheme is £1,465.

Stourbridge.—The T.C. has decided to operate the electric lighting order which it has obtained.

Stretford.—The U.D.C. has resolved to accept the tenders of Messrs. E. Heaton & Son for steam raising plant, £3,095; the Westinghouse Co., Ltd., for steam-driven generators, condensing plant, pipes and accessories, £5,619; and the Anchor Cable Company, for service mains, £9,682. These tenders are in connection with the Council's scheme for electric lighting. The official sanction of the B. of T. has been received for the borrowing of £54,680 for the reconstruction of the tramways and the equipment of electric traction within the district.

Teignmouth.—The U.D.C. has favourably considered an agreement submitted by Mr. Purvis on behalf of Messrs Crompton and Co., who are desirous of supplying electric light within the district, and is to make an application for an extension of time in which to carry out the works authorised by the Council's prov. order of 1899.

Thornhill.— An electrical company intends to apply for a prov. order to supply electrical energy within the district of Thornhill. The T.C. will oppose the application.

Tyneside.—The Felling-on-Tyne U.D.C. has decided that application be made to the B. of T. for its approval of a high-pressure system of electricity supply throughout the district, as requested by the Northern Counties Electricity Supply Company. This is suggested in order that that district may be supplied from Hebburn, the latter town being about three miles to the east of Felling. A similar application was made by the Electricity Supply Company to the Hebburn-on-Tyne U.D.C., and there, too, it was decided to make the necessary application to the B. of T.

Walton.—The U.D.C. has received intimation from the Urban Electric Supply Company of its intention to apply for a prov. order for the lighting of the district. The Council is divided on the question.

Wells.—Messrs. Crompton & Co., Ltd., have offered to erect and work an electric installation in the city at their own cost, and to give the Council the option of taking over the works at stated periods and prices. The T.C. has decided to favourably consider the application.

Weymouth.—A scheme of electric lighting has been approved of by the T.C. The estimated cost is £44,800, and a loan for this sum is to be applied for. It is proposed to charge private consumers 6d. per B.T. unit, and for public lighting 3d. per unit.

Whitstable-on-Sea.—The South-Eastern Electric Lighting Company has given notice of intention to apply for a prov. order for an installation of electric power in the district.

Whitworth.—The Provincial Electrical Supply and Traction Company, Limited, intends to apply for a prov. order to supply electricity in the district.

Windlesham.—The Ascot and District Electric Supply Corporation proposes to obtain powers to supply electricity in Windlesham and Bagshot.

Windsor.—The shareholders of the Windsor Electrical Installation Company have adopted a scheme for the formation of a new company to work the prov. order for supplying electricity in Slough and Datchet.

Wolverhampton.— The accounts of the electricity undertaking for the year ended March 31st last, show that the net result of the year's working, after payment of interest and sinking fund charges, is a profit of £507 13s. 11d. In addition to this the sum of £405 6s. 4d. has been expended during the year out of the revenue of the department in respect of the changing over of the system of supply sanctioned by the Council in November, 1898. The undertaking has also been debited to the extent of about £400 in respect of interest and sinking fund on plant installed for tramway purposes, for which no revenue has been obtained except during the last two or three weeks of the financial year. The gross revenue was £13,240 12s. 8d., and the expenditure £6,745 19s. 8d. The capital account stands at £121,610 10s. 1d. The output for the year was 746,318 units, and the energy generated 1,028,949 units, of which 73,425 were used in the works. The lamp connection amounted to 40,953 8-c P. equivalent.

The report was discussed at the Town Council meeting on Monday. Councillor Crosbie, the acting chairman of the Committee, said the reason why nothing had been written off for depreciation of machinery was that the Incorporated Municipal Electrical Association, at a meeting in February last, decided that no writing off of capital was necessary when the period allowed for repayment of loans was not greater than 30 years. Councillor Fred Evans asked if it was a sound financial balance-sheet unless depreciation was allowed for? He was given to understand there was a lot of machinery at the Corporation station that was becoming obsolete. Alderman Lewis said there could be no doubt there were many thousands of pounds' worth of obsolete machinery at the station. He did not think it was creditable to Corporations that they should make no profit when so many private companies made one. He did not consider the £500 really showed much profit at all. The whole thing was absolutely unsound until recognition was made of what Mr. Evans had said. One consumer in the centre of the town had put in his own installation, and he considered that he could make it at considerably less cost than the prices the Corporation were charging. This was an unhealthy state of things. Councillor White said the balance-sheet was so bad that he felt bound to support what had been said on the question of depreciation, because no class of machinery went out of date sooner than electrical plant. Alderman Joseph Jones said, as there was a great deal of out-of-date machinery, it was a mistake not to provide for depreciation. Councillor Crosbie, in reply, said, on the question of depreciation, he found himself at a loss for a better argument than the one he had adduced, that practically the whole of the Corporations of the country had decided that the system of accounts which Wolverhampton had followed was the correct one. He did not think that Wolverhampton could afford to set up a standard for itself, but if they could say that they were doing exactly as other Corporations were doing, it should be granted that they could not be far wrong. He found that practically the whole of the machinery was in use and doing good work. The Council afterwards adopted the Committee's report.

Yarmouth.—The accounts for the year ended March 31st last show a revenue of £8,441, and a gross profit of £3,442. The net profit is £279.

ELECTRIC TRACTION NOTES.

Aberdeen.—The Tramways Committee has rejected the last 12 electric cars supplied, as after inspection and test they have been found not to comply with the specifications. Mr. Bell, the electrical engineer, contended that the cars were in many points defective.

Bilston and Willenhall.—The cars commenced to run for traffic on Monday on this section of the B.E.T. Co.'s lines, the company taking full responsibility until the Board of Trade certificate is received.

Birkenhead.—Route indicators of the revolving and illuminated type are to be fixed on the Birkenhead electric tramcars. At the last meeting of the T.C. estimates for building new tramway offices at a cost, including furnishing, of £3,050 were accepted.

Denton.—The Urban Council has decided to ask the B.T. to prolong the time for the substantial commencement of the new tramways for a year to August 17th, 1904.

Dublin and Lucan.—The accounts of the Dublin and Lucan Electric Railway Company for the six months ending June 30th show a profit on the working of £971, and the directors propose, after providing for debenture interest, to recommend a dividend of 5 per cent. on the preference shares, place £300 to reserve fund, and carry forward the balance of £82 to next half-year.

Electric Postal Vans.—Experiments are at present being made with a service of electric postal vans for the transport of mails between Rome and Milan. From the trials so far made, it appears likely that these vans will, at an early date, be substituted throughout Italy for the horse cars hitherto employed.

Halifax.—As the result of the representations of the neighbouring authorities concerned, the Halifax Corporation have given instructions for estimates to be got out for extensions of routes from Stump Cross to Hipperholme, Hipperholme to Brighouse, Salterhebble to Greetland, and Salterhebble to Elland

Huddersfield.—Major Druitt has held a Board of Trade inquiry into the tramways accident which occurred here on June 28th, and was mentioned in the Electrical Review for July 4th. The driver of the car, G. W. Hewitt, said he was sure that he did not turn the handles the wrong way. He said that he had not been taught to reverse the motors before the accident. After other evidence had been given, the inspector and witnesses proceeded to the Great Northern Street tram shed, and viewed the damaged car. It was brought out and run along Ray Street, and stopped with the electric brake both when the trolley was on and off. The brake worked perfectly. On returning to the Town Hall, Mr. H. N. Thomas, the manager, stated that when he went to Moldgreen on the night of the accident he obtained two electric cars, and the damaged car was got out and drawn into the road, and hauled to St. George's Square. He then got the controlling handles, and drove the car with its own power to the Great Northern station shed. It was got into the shed and left there, locked up for the night. On the following morning he went to the shed, and in the presence of Alderman Firth, the car was put into the paint shop and locked up. He did this because men would be working in the shed on the Monday. The key was never out of his possession except for one day, when he was out of town, and the key was then in the keeping of Mr. Whiteley, his head assistant. He had examined the car on the morning of the inquiry, and he should consider that it was in perfect working order, especially the electric brake, at the time of the accident.

Mr. F. W. Taylor, electrical engineer, Golcar, stated that the controller was right, and he did not see anything that could possibly have caused it to fail. The car was all right. He had never heard of a car failing temporarily. He was sure that it would be in the same condition now as at the time of the accident. He was of opinion that the electric brake was safe to act if the car was running at 18 miles an hour. Mr. John W. Wainwright, general manager of the British Electric Car Company, Trafford Park, Manchester, said that the car was in good order, and the electrical apparatus was perfect. Mr. J. E. Dyson, electrical engineer, Huddersfield, said that the car was in good order, and should have been pulled up by the electric brake. He could not now suggest any reason why the car should not have been stopped if it was properly handled.

The inquiry was closed.

It is important to note that the Board of Trade inspector thoroughly tested the car without its having been interfered with, and the brakes were found to be in perfect order. The car was driven at full speed and pulled up by both the hand and electric brakes; the inspector then got off the car and expressed himself satisfied. Mr. Thomas then had another run for the benefit of the members of the Press, taking the trolley off the wire and showing them that the electric brake would operate without the trolley being on the wire. This also brought the car up satisfactorily.

London.—L.C.C.—At last week's meeting the Bridges Committee reported that in connection with the reconstruction for electric traction of the tramways between the Elephant and Castle and New Cross Gate, it was necessary to rebuild the bridge carrying the Old Kent Road over the Grand Surrey Canal. It was proposed to substitute a girder bridge for the existing single brick arch at a cost of £3,000, and it was important that the work should be put in hand as soon as possible. The Committee recommended the Council to authorise the issue of advertisements inviting tenders for the work, but the proposal was withdrawn for the present.

The Council adjourned for a week the consideration of a report by the Highways Committee in relation to the reconstruction of bridges in connection with the laying of tramways. The report states that Sec. 17 of the Council's Tramways (Electrical Power) Act, 1900, provides that the cost of reconstruction or alteration of any bridges affected by the electrification of tramways shall be borne by the Council. Several instances have lately occurred of the reconstruction or alteration by the companies concerned of bridges forming part of, or over, roads which are already, or may probably be in the near future, adopted as tramway routes, although no Parliamentary sanction has as yet been given to such tramway routes. The Council has no power to require the companies to so carry out the work as to permit of electrical conduits being placed in the carriageways of the bridges, or, in the cases of bridges crossing roads, to require that the headway shall be sufficient to permit of the passage underneath the bridge of a loaded car, or that the buttresses shall be sufficiently far apart as to permit of a double line of tramway being laid on the road. Moreover, even if the company concerned is willing to make the necessary alteration to meet these points, in the structures of the bridges, provided that the Council will pay the whole or a part of the cost, the Council has no statutory power to enter into any such arrangement. It is very desirable that the Council should endeavour to obtain this power. One great reason for considering this desirable is that, in some cases, when a bridge is being reconstructed or altered, the additional outlay necessary to adapt the bridge for the purpose of electrical conduits being laid in the carriageways, or for tramways to be laid in the road beneath, would be inconsiderable as compared with the cost which would have to be incurred afterwards, of the necessary reconstruction or alteration being made of the superstructure or abutments. The Committee therefore propose that the Council should seek the powers desired in the next session of Parliament.

At Tuesday's meeting it was decided, on the recommendation of the Highways Committee, to approve an estimate of £205,000, and to enter into an agreement with the South London Tramways Company for the purchase of the whole of the company's undertaking for £198,500, the transfer to take place on November 1st next. In a report by the Finance Committee, it was pointed out that the company's profits for the past financial year amounted to £11,400. This sum would be about sufficient to meet interest and sinking fund on the cost of acquisition by the County Council, but would leave little or no margin for the increase in wages, and it was, therefore, probable that the immediate result of the purchase would be a deficiency. The Committee submitted, however, that it must be borne in mind that full advantage could not be obtained from these tramways until they had been converted to electric traction.

The Highways Committee reported that it would be necessary to obtain electric cars of a special kind for use on the Streatham lines, with the bodies of the cars carried on single trucks, and not on bogies as in the case of those for the Tooting tramways. The reason for single-truck cars being preferred instead of bogie cars, was that the gradient of Streatham Hill is steep, and experience had shown that the maximum traction trucks had given considerable trouble on heavy gradients as the driving wheels had a tendency to slip in mounting a hill. Moreover, the weight of a single-truck car was about 2 tons less than that of a bogie car, and as the new cars would have at first to be pulled by the cable, the difference in weight was of considerable importance. The Committee mentioned that provision had been made in the specification for raising the plough from the slot at the junction of the electric and cable lines, and also for apparatus for gripping the cable. It was estimated that the cost of the number of cars required for the Streatham lines would amount to £59,000, including provision for the necessary appliances to enable the cars to run over both electric and cable lines. The contract for the cars should be let as soon as possible, so that they might be ready for delivery by the time the Tooting lines, over which they would run in connection with the Streatham tramways, had been reconstructed. On the recommendation of the Committee, authority was given for the issue of advertisements inviting tenders for the supply of the single-truck cars.

After a brief discussion, the Council resolved to apply in the next session of Parliament for powers to enable it to contribute, in connection with the reconstruction or alteration of any existing bridges, the whole or a part of the extra cost likely to be incurred in adapting the bridges so as to allow of the placing of electric conduits in the carriageway of the bridges or the laying of a double line of tramway in the road beneath such structures. [This matter came before the previous Council meeting as stated above.] Before the resolution to this effect was adopted, the chairman of the Highways Committee explained that such powers, if granted, would result in the saving of many thousands of pounds.

An expenditure of £30,000 was authorised for the erection of car sheds at Clapham, and of £3,500 for the supply of fuel economisers for the Greenwich power station. Authority was given for tenders to be invited for the delivery of the latter. At the next meeting the Council will be asked to vote £114,000 for the reconstruction on the conduit system of the tramways between New Cross Gate and Greenwich.

The Southwark Borough Council has received notice of the L.C.C's. intention to lay underground mains in Newington Butts, London Road, St. George's Market, St. George's Circus, Westminster Bridge Road, and Blackfriars Road, in connection with the electrification of the tramway system.

West Ham.—It is stated that the West Ham Borough Council have just accepted a tender amounting to £108,900 for the construction and equipment of a system of electric trams for the borough. The rails are to be made in England.

Gloucester.—The inquiry into the proposed schemes of electric tramways in Gloucestershire, connecting the towns of Gloucester, Cheltenham and Stroud, has been fixed to take place at Gloucester on July 31st, and already all parties interested in the matter are actively preparing evidence and securing signatures to petitions to place before the Commissioners. No arrangement has been arrived at between the conflicting interests, and the fight practically resolves itself into a contest between the Gloucester Corporation and the outside districts. Mr. T. Nevins desires to carry out a network of tramways in the Stroud and Cheltenham district, which will also run into Gloucester. It is in connection with the latter line that all the friction has arisen, and the Gloucester Corporation, who are going in for a scheme within their own area, object to Mr. Nevins having any running powers over a portion of road which the Corporation eye very jealously, having regard, no doubt, to possible extensions of the city boundaries in the near future.

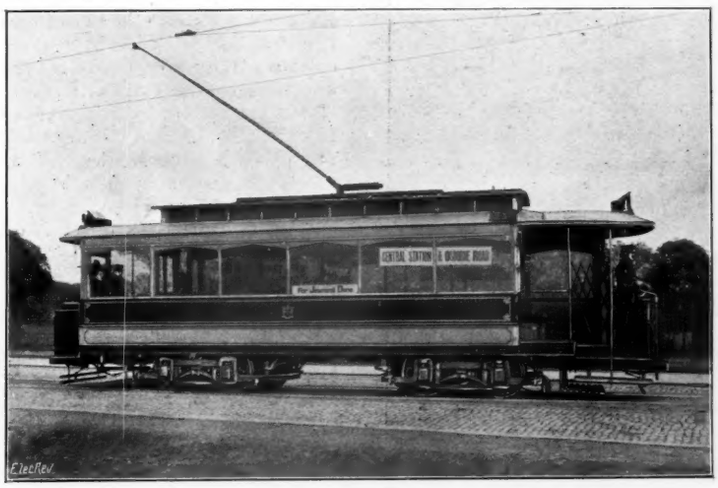
Ilford.—The U.D.C. having come into conflict with the Ilford Gas Company regarding the interference of the Council's tramways with the gas mains, the matter was submitted to arbitration. The award of the arbitrator was recently issued, and is wholly in favour of the company. The Council will therefore have to lower the gas mains over a very considerable distance, and move them laterally where necessary. The cost of the award is to be borne by the Council.

Italy.—The engineer, Signor Mario Boughi, of Naples, has published a study on his project for the construction of a system of electric railways of narrow gauge, to be constructed in the province of Foggia, which is entirely separated from the rest of Italy by the Targano range. The centre of the system will be at San Severo. From this point lines will radiate towards Lucera, Torre, Maggiore, Manfredonia, Carpino, Rodi, Vieste, and Monte San Angelo. The total length of the proposed lines will be a matter of 239·4 kilometres, and the cost of the undertaking will not be less than 13,500,000 lire.

(*Continued on page* 112.)

THE ELECTRIC TRAMWAY SYSTEM OF NEWCASTLE-ON-TYNE.

Now that the electric tramways of Newcastle-on-Tyne have been running for about six months, with all the routes open that were originally to be constructed, the following account of the whole of the installation may interest our readers.

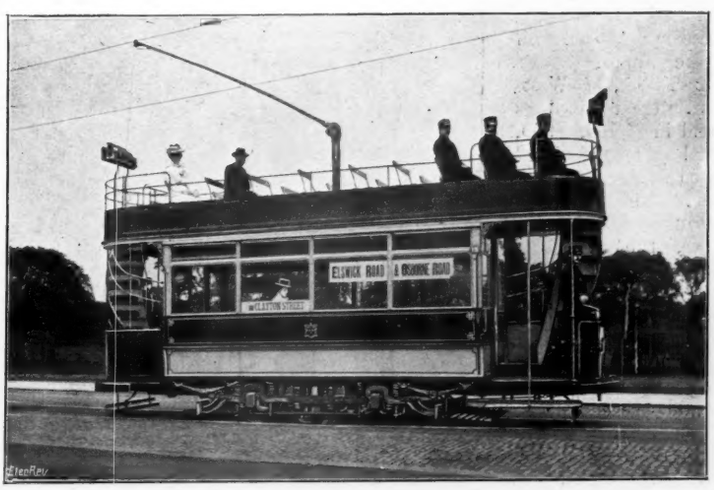


Single-Deck Bogie Car.

Newcastle is a very hilly town, situated as it is on the steep banks of the River Tyne, and is peculiar inasmuch as the city is almost divided into halves by the large open space called the Town Moor, which compresses the strictly business part of the city into a very narrow portion between the river and this Moor.

The borough itself has a population of about 216,000, but a great number of people live in the neighbouring districts of Benwell, Gosforth and Walker, and travel to and from their work in Newcastle, and this fact has already caused the Corporation to go to Parliament for a Bill enabling them to construct extensions of the originally-arranged lines in the borough, outside its boundaries, into these districts.

The tramway question in Newcastle has, from its inception in 1879, been subject to keen controversy. In that year the Corporation obtained a tramways order, under which they constructed about 11 miles of single track, and leased them to a company, which worked them by horse haulage down to May, 1901.



Double-Decked Car with Reversed Stairway.

The original lease was to expire in 1899, and before that time came the question arose as to what type of mechanical power should be adopted for the tramways, and whether the tramways, as converted, should be municipalised or leased to a private company.

It was seen that the adoption of mechanical power was a *sine quâ non* owing to the way in which the town had outgrown the traffic facilities that horse tramcars could give it, but whether electrical power or whether cables should be adopted, was an open question, and one over which controversy arose.

Experts were called in, and gave estimates of the cost at which either of the rival systems could be constructed. Both estimates were made out on the lowest basis on which the tramway system could be constructed, and the electrical overhead system triumphed; but, of course, when it came to construction, it was found that, though each estimate would probably have given a workable system, yet neither gave any margin for spare plant, and the completed system, therefore, cost a good deal more than the original estimate.

In April, 1899, the first rail was laid by Mrs. Cail, wife of the chairman of the Tramways Committee, and from that time the work was pushed forward as speedily as possible, in spite of the difficulties encountered, owing to the fact that the horse tramways system had to be kept running, till, in May, 1901, the Corporation determined to do away entirely with the horse trams, and thus enable the construction of the new track to be got on with more rapidly.

By December, 1901, part of the system was ready for running. The power station was almost complete, and on the 16th of that month the first cars started in regular traffic.

During the construction of the buildings, a bricklayers' labourers' strike began in the district, and for nine months not a single brick could be laid in any building, the consequence being that the Corporation, for the large car sheds, gave up entirely the use of brick, and substituted a steel and concrete structure, whilst in the power station the roof was put up on steel uprights, and the walls were begun in concrete.

The delay in the buildings which ensued obliged the Corporation also to put off the construction and delivery of

cars, the consequence being that not until some time last month has the whole of the originally intended system

Newcastle Tramways: Power Station.

been able to be completed and provided with sufficient cars for running.

The track is laid on a heavy foundation of concrete, 7 in. deep, and consists of steel girder rails 101 lbs. to the yard and 45 to 60 ft. in length, bonded at each joint with two 0000 flexible Crown bonds, and cross-bonded at every 120 ft.

In the space between the two tracks conduits have been laid over the whole of the system, sufficient to provide for any extensions of tramways and public lighting purposes which may be likely to take place.

The ducts used are of various types, Albion Clay Company's, Doulton, and National Conduit Company's, and all are laid in lengths not exceeding 400 ft., with manholes at the end of each length.

Messrs. Hopkinson & Talbot, of Westminster and Manchester, were retained as consulting engineers, and in March, 1900, Mr. A. E. Le Rossignol was appointed resident engineer for the consulting engineers and for the Corporation. The whole of the work was carried out under his supervision, and in November, 1901, he was appointed general manager and engineer.

Various sites in the town were at the disposal of the Corporation, and the consulting engineers chose one at Pandon Dene, which had the advantage of being practically at the centre of distribution of the whole system, but had the disadvantage of being entirely on filled-in ground, about 90 ft. deep, over a former narrow dene or valley.

Mr. B. F. Simpson, of Newcastle, was appointed architect for the power station, and it was determined to float the buildings over the filled-in ground on a heavy block of concrete, stiffened by steel rails laid transversely and longitudinally. One block is about 280 ft. long, and carries the whole of the engine room and a block of offices for the use of the tramway staff. This block is 8 ft. thick and 76 ft. broad. The boiler house is carried on a similar block 104 ft. long by 94 ft. broad; whilst the chimney has piles driven in 30 ft., and on the top of these there is a block of concrete 8 ft. deep by 30 ft. square.

The site adjoins the main line of the North-Eastern railway to the North, and lies at a much lower level, so that by the construction of a high timber and steel gantry (the steel portion of which will form an extension of the boiler house in the future), coals are brought direct in the North-Eastern wagons into the top of the boiler house. A double line of railway track has been run on this siding, which was constructed to the designs of the resident engineer, and on it a powerful electric locomotive takes delivery of a whole train of wagons, which pass first over a weigh bridge, and bring in up to 200 tons at one time. All the North-Eastern railway wagons, as our readers may know, are provided with hopper bottoms, and when brought into the boiler house, striking up a trigger lets the bottom fall out of the wagon, and empties the coals direct into the bunkers below the track.

The boiler house itself consists of a steel framed brick building, with steel principals for the roof, of three stories and basement. The latter forms the space for the handling of ashes; above this is the firing floor; above this the sloping coal bunkers, and above this the railway siding for the reception of the wagons.

(To be continued.)

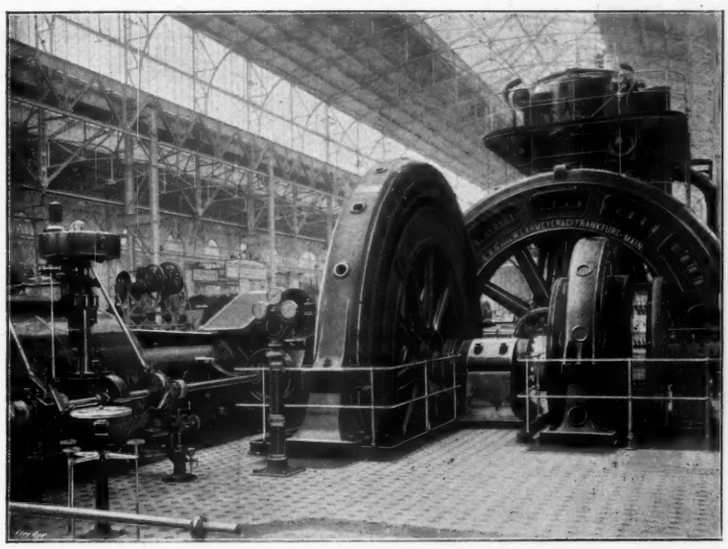
ELECTRICAL PLANT AT THE DÜSSELDORF EXHIBITION.

(*Continued from page* 69.)

A three-phase 750-kw. Lahmeyer alternator is shown in conjunction with Messrs. Haniel & Lueg, of Düsseldorf, and will be described later. The only remaining generator of this kind is one which is mounted on the same shaft with a direct-current generator, as shown in the illustration on the following page. These machines are direct-driven by a horizontal tandem-compound single-crank engine, built by the

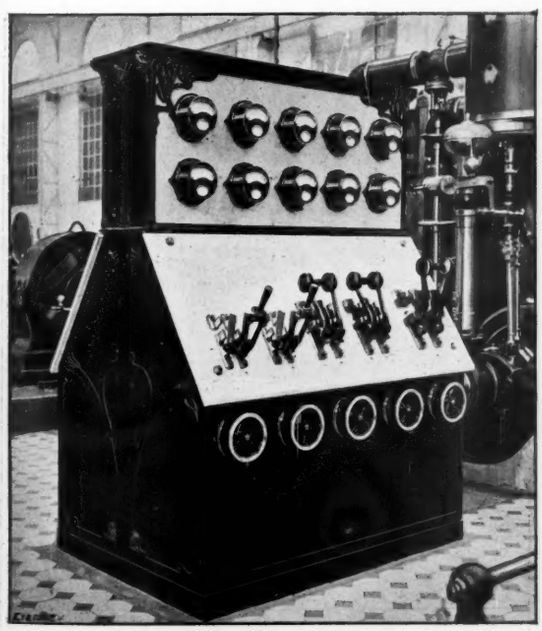
Newcastle Tramways: Trolley Coal Wagon on Top of Power Station.

Maschinenfabrik Hohenzollern, with trip-valve gear, running at 94 revolutions per minute, and capable of developing 800 H.P. at normal load, 1,000 H.P. maximum. The alternator is rated at 500 KW., at 5,000 volts, while the dynamo gives 400 KW., at 600 volts; the total, 900 KW., being obviously much more than the maximum output of the engine. The set is destined for the works of the Rheinische Bahngesellschaft, Düsseldorf. The alternator is of the standard Lahmeyer type, with double-armed fly-wheel; there is a bearing between the alternator and the dynamo, and the armature of the latter is carried on a short shaft coupled to the alternator shaft. The difference in diameter of the two machines is striking, compared with the difference in their respective outputs. The building of this "double-machine," as it is called, is of interest, having regard to the recent paper at the M.E.A. Convention advocating "double-current" generators, and to Mr. Rider's work at Plymouth.

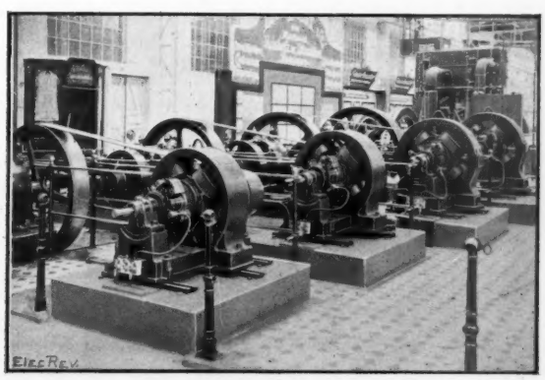


COMBINED D.C. AND A.C. LAHMEYER GENERATING SET.

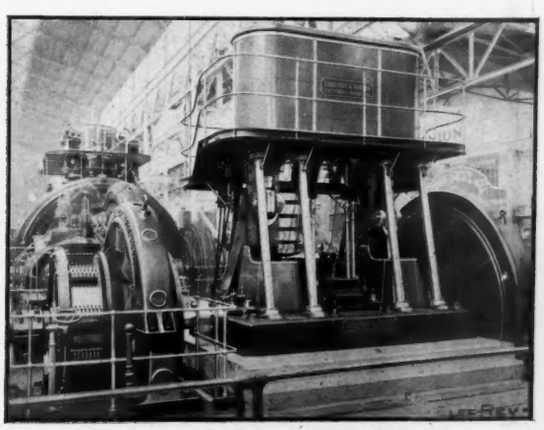
Of direct current generators, Messrs. Lahmeyer have a large display. One of these is of special interest, as illustrating the firm's fly-wheel type of dynamo; it is shown in one of our views (p. 110), coupled direct to a vertical low-speed compound engine built by the Dingler Engineering Works, of Zweibrücken. The engine is rated at 500 to 650 H.P., and runs at 120 revolutions per minute; the cylinders are 600 and 950 mm. in diameter, and the stroke 700 mm. The large diameter of the armature, and consequently of the field magnet frame, is very noticeable; no additional fly-wheel is provided, though the dynamo is intended for electric traction, having an output of 450 KW. at 600 volts. The set is to be erected in the Homburg Electricity Works after the close of the Exhibition. The construction of the machine, except for the larger diameter, is generally similar to that of the ordinary type; the armature is 3,200 mm. in diameter, with a series-parallel bar-winding and equipotential connections. The weight of the core is about 3,100 kg. The commutator has 860 bars, and is 2,200 mm. in diameter. The field magnet consists of a cast-iron frame carrying 16 steel poles; the outer diameter of the frame is 4,600 mm. The weight of the rotating parts is 16,700 kg., and the fly-wheel effect (WD²) is 33,800 m² kg. The diameter of the shaft in the armature is 350 mm., and in the bearing 225 mm.; the length of the bearing is 360 mm.



LAHMEYER CABINET SWITCHBOARD.



BELT-DRIVEN LAHMEYER DYNAMOS.

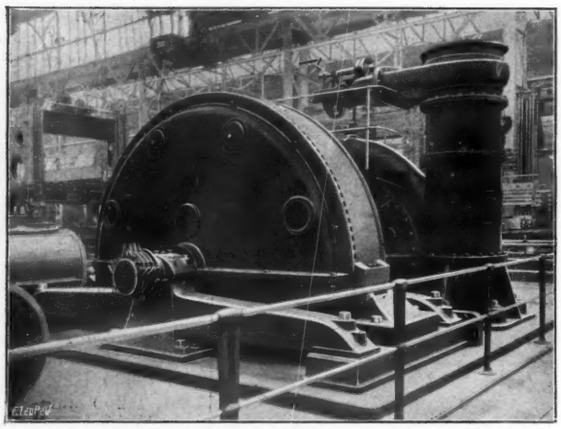


275-KW. STEAM DYNAMO.

Near this set are four belt-driven Lahmeyer dynamos, used for exciting some of the alternators. Each of these is

driven by a horizontal single-cylinder Dingler engine, of powers ranging from 30 to 85 H.P., and speeds from 225 to 180 revolutions per minute.

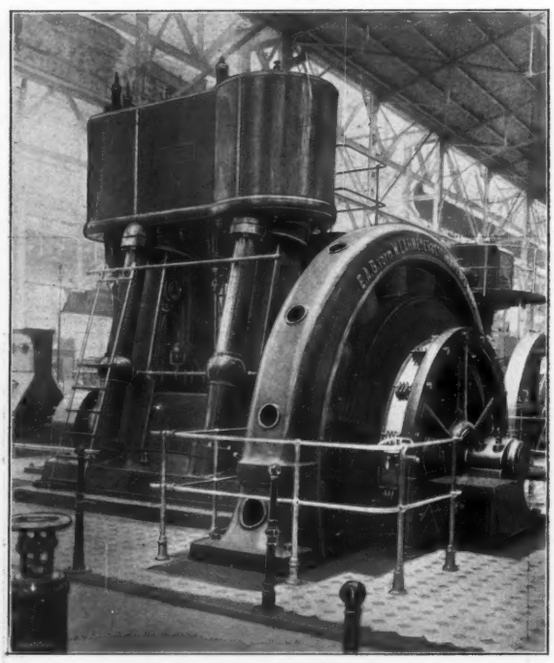
The normal type of direct coupled dynamo is shown in our view of a 275-KW. machine, driven by a vertical compound



CENTRIFUGAL PUMP DRIVEN BY INDUCTION MOTOR.

engine built by Messrs. Ehrhardt and Sehmer, Schleifmühle. The engine is of the marine type, and has a heavy fly-wheel at the end of the shaft remote from the dynamo. The armature of the latter is drum-wound for 220—250 volts, at 150 revolutions per minute; its construction is well shown by the cross-section reproduced herewith, and will be seen to differ in many respects from English practice. The core is well ventilated, and the temperature of any part does not rise more than 45° C. in continuous running at full load. The magnet poles are of wrought-steel, fixed to the yoke with bolts, and the commutator centre is bolted up to the end of the armature spider.

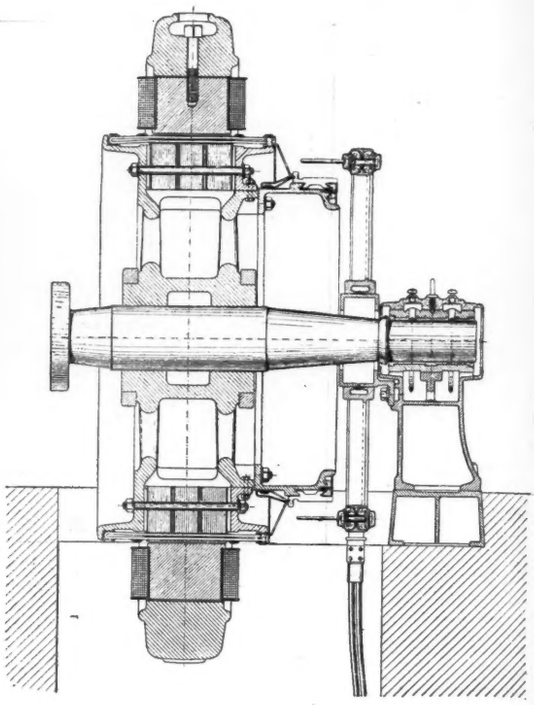
To avoid obscuring the view of their exhibits, Messrs. Lahmeyer have adopted the type of switchboard shown in



450-KW. FLY-WHEEL DYNAMO.

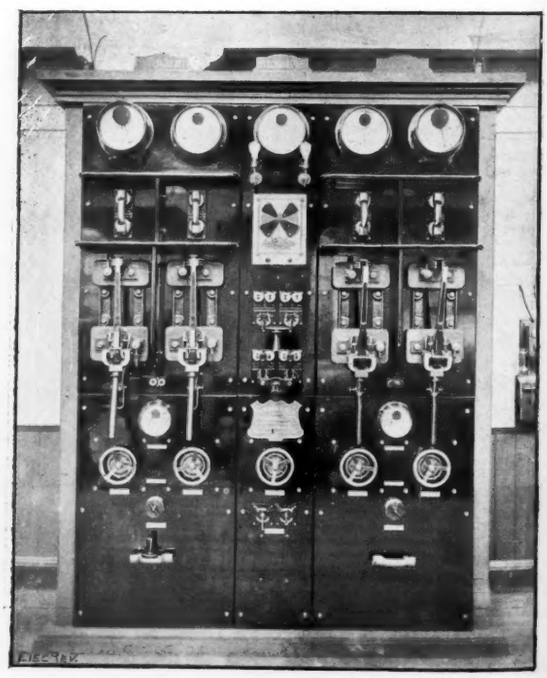
one of our illustrations; this carries all the instruments, switches and rheostats required for controlling a group of machines, in a convenient and compact arrangement.

Several other direct current machines, coupled to engines by various makers, are shown; those which we illustrate, however, will serve as examples of the leading types exhibited. We should mention that one set, consisting of a 440-KW.



CROSS-SECTION OF 275-KW. DYNAMO.

600-volt Lahmeyer dynamo coupled to a compound horizontal single-crank engine built by the Union Works, Essen, has an extra heavy fly-wheel, and the armature shaft



ROTORUA: MAIN SWITCHBOARD.

is connected to the engine shaft by means of a coupling outside the main engine bearing. It is intended to instal this set in a generating station, at present supplying direct current; when, as is anticipated, three-phase plant is to be substituted, the magnet system will be built up on the cir-

cumference of the existing fly-wheel, the stationary armature of the alternator added and the dynamo disconnected, with a minimum of expense and delay.

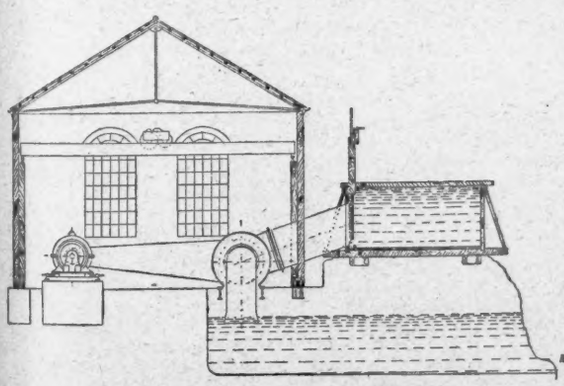
In an adjoining exhibit—that of Messrs. Haniel & Lueg, of Düsseldorf—other Lahmeyer machines are met with. One is a three-phase induction motor, coupled to a centrifugal pump, intended for the dry docks at the Imperial Shipyard, Kiel. This is of a rated power of 310 B.H.P, and runs at 165 revolutions per minute. The stator frame is in two parts, stiffened by two-part shields, which are journalled upon the bearing, but are normally bolted fast in place. On removing the bolts, the whole frame can be rotated, the outer circumference being provided with teeth for this purpose. The rotor is built up in one piece. As the motor is enclosed so as to be watertight, special arrangements for artificial ventilation are provided; cold dry air is driven in through a special pipe. The slip rings are not enclosed. The greatest diameter of the frame is 3,780 mm., and the weight of the frame complete 12,500 kg. The diameter of the rotor is 2,995 mm., and its weight 5,000 kg. The outer diameter of the stator core is 3,300 mm., and the bore 3,000 mm.; the breadth is 260 mm. The machine is built for a pressure of 1,000 volts and a frequency of 50 cycles per second; there are 36 poles. The winding of the stator is laid in 324 grooves, and that of the rotor in 432.

(To be continued.)

ELECTRIC POWER TRANSMISSION IN NEW ZEALAND.

(Concluded from page 67.)

The general arrangement of the switchboard is shown in the photograph on p. 110. It is divided into three enamelled slate panels, fitted into an angle iron frame. The two outside panels each represent an alternator and contain an A.C. ammeter, electrostatic voltmeter reading up to 4,500 volts connected across the main terminals of the machine, a double-pole main high-tension switch, double-pole high tension fuses, exciter field shunt switch, with an extra contact for short-circuiting the shunt coil as the circuit is opened, exciter field shunt regulator, field ammeter and synchroniser sockets and connections. The centre panel contains two



Section of Rotorua Power Station.

synchronisers, of the ordinary double transformer pattern, on the back of the board, switches and fuses, and lamps for synchronisers, a two-way double-pole switch to allow of the station lighting circuit being connected to either of the exciters, and the resistance regulator, before mentioned, for keeping the voltage of the lighting circuit constant. A Stanley earth detector is also provided. The arrangement of the switches, &c., permits of either alternator being connected to the line, or if necessary, the two can be put in parallel on to it.

The transmission line consists of a ·0223 in. sectional area bare copper wire for lead and return, 13 miles long. It is supported on white porcelain triple shed insulators. The poles are steel railway rails, 24 ft. long, and were dipped in hot gas tar before erection. They are placed, on an average, two chains apart, and will be practically everlasting, whereas timber ones would probably want renewing in this locality in the course of 10 or 12 years. The ground in which the poles are set is, generally speaking, of a fairly soft pumice gravel, but in some few places hard rock was met with, and blasting had to be resorted to. The line is protected at each end by Siemens horn arresters, but on account of the use of iron poles it was not considered necessary, although the district is at times subject to severe thunderstorms, to provide lightning arresters along the line, as the poles themselves will act as lightning conductors.

At the town end the line terminates at a switchboard in the pump house. This board is like the one in the generator house. The high-tension panel contains high-tension switches and fuses for separate incandescent and arc circuits. There are also two double-pole switches and fuses, by which either or both of two 12-KW. transformers in the pump house can be connected to the line. These transformers are used for the 8-H.P. motors for driving the sewerage pumps, and also for running the lights in the pump house. The low-tension panel contains double-pole switches and fuses on the secondaries of the transformers, to enable either of them to be connected with either of the motors, or to the lighting circuit.

The motors are of the induction type. Each drives by means of a leather link belt a 5-in. Jennings centrifugal pump. At full load, each pump will raise about 500 gallons per minute 25 ft.

The distribution mains are all insulated with vulcanised rubber and braided. They are run on porcelain insulators on rata arms, keyed and bolted to Totara timber poles. There are separate circuits for the arcs and incandescents; transformers are fixed where required on the poles, so that no high tension wires are carried in or on to the buildings; they receive the current at 3,000 volts and transform it down to 100 volts.

In some cases a separate transformer is used for a single building; in others, adjacent buildings are fed from one transformer. Every transformer is fitted with D.P. high tension switch and fuse and earth shield between primary and secondary winding.

The atmosphere of Rotorua is heavily charged with sulphur, which quickly acts on all exposed metal work. Silver, brass and plain iron particularly suffer badly; galvanised iron stands fairly well. A portion of the main line in proximity to the town had turned to the colour of lead before it had been up a week, and Mr. Haes would not like to say how many years it will last.

A separate high tension circuit runs from the pump house through the town for the various lamps. There are at present 20 enclosed alternating current arcs erected in the streets and gardens, each taking 6 amperes at 100 volts. The lamps are fitted with choking coils, which reduce the pressure to 70 volts at the arc. The current is transformed from the 3,000 volts at each lamp by a Brush arc lamp transformer.

This method was adopted on account of the lamps being very scattered, and it has the advantage of making every lamp independent of the others.

There are about 250 lamps of different powers in the Government buildings, and another 150 private lights already connected, making with the arcs a total load equivalent to about 1,100 8-C.P. lamps installed. Other places are now being wired and connected up, and the load will very soon be equal to the capacity of one unit of the plant. Current is supplied by meter, and the rate has been fixed at 6d. per B. of T. unit.

Bradford Labour Conditions.—The Bradford Corporation has been inviting tenders for the electric lighting of its new central fire station. Yesterday was the latest date for sending tenders, but the conditions laid down for tenderers are remarkable enough, and ridiculous enough, to warrant our placing them on record in these columns:—"Persons tendering must give an assurance that they have paid to their workmen *for the three months preceding date of tender*, not less than the minimum standard rate of wages, and undertake to continue to pay, during the contract, the said rate of wages."

ELECTRIC TRACTION NOTES.

(*Continued from page* 106.)

Liverpool.—A further extension of the southern outer belt lines of the Liverpool electric tramways is about to be made from Croxteth Drive to a point in Aigburth Road.

Mexico.—The Mexican Railway Company have decided to convert the steam railway between Esperanza and Vera Cruz into an electric line.

Newcastle-on-Tyne.—At the meeting of the Committee having charge of the Newcastle tramways last week, the chairman, Mr. Cail, stated that the present electrical power possessed by the Corporation was sufficient to work the tramways, but to provide for a breakdown, and also having in view the extension to Walker, he suggested that they should have another engine of 3,000 H.P. This was agreed to. It was also decided to order more cars, and that the resident manager, Mr. Le Rossignol, should submit plans of various kinds of cars for the next meeting.

Sunderland.—At the meeting of the Council on 9th inst. Councillor Summerbell, the vice-chairman of the Tramways Committee, dealt at some length with some adverse criticisms which had been passed upon the annual report of the Committee. The criticisms were, that the purchase of the old Tramways Company's undertaking was not a serious matter; that there was existing a generating station; that the old car sheds were available for the storage of the electrical cars; that they had made unfair charges against other departments of the Corporation; that they had only paid 3·46 per cent. on the tramway capital; and that the accounts of the report were "cooked." To this Mr. Summerbell replied categorically. The purchase of the old undertaking meant that £21,000 was dead capital, as they bought the concern for £35,000, but only realised £14,000 by the sale of material. The generating station had had to be extended as to buildings, boilers, engines and dynamos; the reconstruction of the old car sheds cost more than the erection of new ones would have done. He declared it was untrue that other departments had had to bear cost for the tramways, except a little legal and accountancy work. The Tramways Committee had spent large sums on works of alteration and paving, some of which would have had to be done by the Highways Committee but for the Tramways Committee doing it. As a matter of fact, they had spent about £62,000 for paving streets alone. As to the question of interest, if they took the gross profits it worked out to 17 per cent. He emphatically denied that the accounts had been in any way tampered with. In conclusion, he said they had added £5,000 to the reserve fund, £6,700 to the sinking fund, £5,400 to the depreciation fund, and given £7,000 to the relief of the rates, as well as paying £1,000 as ratepayers. While they had done all this they had given a more efficient and up-to-date system; they were carrying people at 33 to 50 per cent. less cost than did the old company; they gave their men a six-day week as against a seven-day week, and a 10-hour as against a 14-hour day; they paid drivers 32s. 6d. as against 25s. to 28s., and the conductors 22s. 6d. to 25s. 6d. as against 12s. to 20s. The Committee's report was carried unanimously.

Swindon.—The B. of T. has prolonged the time for the construction and completion of the municipal tramway for a period of 12 months.

Worthing.—After a long discussion the T.C. on Friday last decided to take steps to secure an order authorising the construction of nine lines for electric trams in the borough.

TELEGRAPH AND TELEPHONE NOTES.

Cable Contract.—We hear that the Telegraph Construction and Maintenance Company have obtained the contract for the Mackie cable from the Sandwich Islands to Manila.

The Fire at the London Wall Exchange.—The National Telephone Company, Limited, writing from Telephone House Victoria Embankment, with reference to the unfortunate destruction of the company's London Wall Exchange, state that the adjoining premises, which were occupied by the company as offices, were cleared out immediately after the fire to form the site of a temporary exchange. The work of fitting up this exchange is proceeding with the utmost rapidity. In addition to this, the Bartholomew House Exchange, which is a local exchange in connection with the Stock Exchange, but which was not joined up to the company's general system, has, with the permission of the Exchange Telegraph Company, been joined up to the general system; and between 300 and 400 members of the Stock Exchange who are on the Bartholomew House Exchange have now got temporary service through that exchange. With regard to the restoration of the permanent exchange, all requisite instructions for the re-construction of the building have been given, as well as telegraphic instructions for the new switchboards, and the necessary work will be pushed on as rapidly as possible.

The New Gutta-Percha.—For the last 20 years or more innumerable efforts have been made to produce artificial gutta-percha, but in the words of one who has perhaps had more to do with gutta-percha substitutes than any other person, every attempt has been foredoomed to failure, and the reason is not far to seek. The chemical analysis of gutta-percha shows it to be composed of about 60 per cent. of india-rubber and 35 per cent. of resin and a small proportion of impurities. At first sight it would appear a comparatively simple matter to arrange to mix india-rubber and resin so that finally the proportions should be as above. An insurmountable difficulty, however, exists in the fact that at a comparatively low temperature, the resinous mass becomes fluid, so that long before a temperature is reached at which india-rubber could combine with resin, the latter has been reduced to a thin fluid, and the act of combination thereby rendered imperfect, if not impossible. In the result a gutta-percha substitute is soft and readily takes the impression of the nail, and at a temperature little above normal becomes sticky. On being raised to the temperature of boiling water it soon becomes soft, but does not usually on cooling return to its original condition, and remains more or less sticky and plastic. About 10 years ago a German chemist set to work to produce gutta-percha synthetically, and after numberless experiments and most exhaustive testing of their results, he produced a material which is stated by several high scientific authorities to possess properties which in no case are inferior to those possessed by natural gutta-percha, but that are in some directions even superior.

The new gutta-percha has been under the observation of the German Post Office officials for several years, and the manner in which this material has endured the tests to which it has been subjected—both in their official testing laboratory and also at the works of Messrs. Felten & Guilleaume—has justified them in commencing its adoption for the insulation of submarine and subaqueous wires and cables to be used on their telegraph and telephone systems.

These statements are confirmed in an official certificate issued by the Imperial post office.

Reports upon this material made by Prof. Weber, of the Zurich Polytechnic, Mr. Ed. C. de Segundo, A.M.I.C.E., and other authorities set forth the following facts:—

1. That the new gutta-percha is fully equal to natural gutta-percha, and, in fact, possesses some characteristics which render it even superior to natural gutta-percha.

2. That it does not soften until a higher temperature is reached than in the case of natural gutta-percha.

3. That its electrical resistance is somewhat higher than that of pure gutta-percha.

4. That the inductive capacity is practically the same as that of natural gutta-percha, perhaps a little less.

5. That all the ingredients used in its manufacture are readily obtainable in most countries, and that there is little likelihood of the prices of any of the ingredients tending to rise.

6. That no natural gutta-percha whatsoever is used in the manufacture.

7. That the price at which it can be produced in this country in a quality equal to that of natural gutta-percha for the insulation of submarine cables is less than one-half the present price of gutta-percha.

We have examined samples of this material, and while, of course, we have not had an opportunity of subjecting it to the elaborate tests which would be necessary to enable us to express our own opinion upon such properties, for instance, as the inductive capacity, we can only say that as far as our observations go, it is very greatly in advance of any gutta-percha substitute that has hitherto been placed upon the market. From the point of view of submarine telegraphy, the constancy of the electrical resistance and of the inductive capacity is, of course, a condition *sine qud non* to the use of this material in the place of natural gutta-percha. We are, however, assured that some submarine and subaqueous cables have already been made on the Continent, the cores of which are insulated with the new gutta-percha, and that these cables have been in use for over a year, and have yielded results as regards both electrical resistance and inductive capacity that are absolutely satisfactory. Apart from the question of the use of this material for the insulation of submarine cores, the low price at which it can be produced, coupled with the excellence of its physical and electrical characteristics should open up a wide field for its use in many industries, and we shall look forward with interest to its development in this country. The German and other European patents have already been acquired, and a company has been formed to deal with the British and Colonial patents. This company has been privately subscribed and no issue will be made to the public. We hope at an early date to have an opportunity of going further into this interesting invention and to be able to publish the results of various tests.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	
Communication with Carthagena and Barranquilla (Columbia)	Dec. 8, 1900	
Trinidad-Demerara No. 1	Aug. 27, 1901	
Communication with Bolama	April 18, 1902	
St. Lucia-St. Vincent	May 8, 1902	
St. Lucia-Grenada	May 8, 1902	
Dominica-Martinique	May 8, 1902	
St. Lucia-Martinique	May 8, 1902	
Guadeloupe-Martinique	May 9, 1902	
Santa Cruz de Teneriffe to Tejita de Teneriffe	July 4, 1902	
Puerto Plata-Martinique	July 10, 1902	
Cap. St. Jaques-Haiphong	July 12, 1902	
Communication with Annam and Tonkin	July 13, 1902	July 14.
Landlines:—		
Route via Hanekin on Persian territory	Feb. 24, 1900	
Communication with Tientsin and Taku via Helampo	July 1900	

New Cable Steamer.—The Germans are building a cable steamer at Stettin. The design of the vessel, which will be fitted with all the latest improvements, is on the lines of the Telegraph Construction and Maintenance Company's ship *Anglia*.

Scarborough Telephones.—The T.C. has decided to apply to the Postmaster-General for a license to provide a system of municipal telephones for a period of 10 years within the area assigned to the telephone company.

Telephonic Fences.—Barbed-wire fences are said to be utilised for telephonic communication among the farmers in the neighbourhood of Woodland, California. The greater part of the lines consist of wire fences running along the sides of the roads or dividing the farms, poles and elevated wires being supplied wherever necessary. Branches or loops are added extending to the residences of the farmers living along the route. The undertaking has proved so successful that the original promoters have induced others to join them, and the line is to be greatly extended.

Wireless Telegraphy.—A daily paper says that the curators of the Jubilee Foundation of German Industry have awarded Prof. Slaby £1,000 for the purpose of enabling him to prosecute his studies in connection with wireless telegraphy.

The South-West Wireless Ship Telegraph Company has been formed in Liverpool to put the Marconi system to a practical test on a commercial scale. It is proposed to establish a floating station on the high seas at about 110 miles west of the Lizard.

The *Daily Telegraph* says that Mr. Marconi, who joined the *Carlo Alberto*, Italian flagship, off Dover on the 7th inst., has sent the following telegram to Mr. Hall, the manager of the Marconi Company:—"Have received messages as far as Cape Skagen in Denmark, and signals as far as Cronstadt. All attested by ship's officers. New magnetic receiver beats all the others for sensitiveness." The paper referred to adds:—"The distance from Poldhu in Cornwall, from which the messages were sent, to Cape Skagen is nearly 900 miles, and though this falls short of the transmission to the steamer *Philadelphia* 1,500 miles from the Cornish station, it is more important, because more than one-third of the route of the etheric waves in the present case was over land. The magnetic receiver is one by which Mr. Marconi said at the Royal Institution he hoped to be able to transmit messages at the rate of several hundred words per minute." We refer to this matter in our "Notes" columns to-day.

CONTRACTS OPEN AND CLOSED.

OPEN.

Accrington.—July 21st. Lancashire boiler and piping for the electricity works. See "Official Notices" July 11th.

Amsterdam.—September 8th. Underground high pressure and low pressure cable system (three-phase, direct and telephone). See "Official Notices" July 4th.

Antwerp.—July 24th. An adjudication will be held at Antwerp on this date for the supply of 400 galvanised steel cables. Particulars from the Direction des Voies et Travaux, 11, Rue de Louvain, Brussels.

Austro-Hungary.—Sept. 1st. The municipal authorities of Klausenburg (Kolozsvar), Siebenbürgen, are inviting tenders until September 1st, for the establishment in the town of a central station for electric lighting and power purposes. Tenders are to be sent to Bela Fekete Nagz, Kolozsvar, from whom particulars may be obtained. See "Official Notices" May 9th.

Barking Town.—July 31st. Rails, fishplates, bolts and permanent way construction for the U.D.C. See "Official Notices" July 4th.

Bradford.—July 24th. The Corporation are inviting tenders for an installation at the new conditioning house, Canal Road. Tenders close on the 24th inst.

Brussels.—July 23rd. At the Société Nationale des Chemins de fer Vicinaux, 14, Rue de la Science, Brussels; supply and installation of aerial feeders, &c., for the sections, Grâce-Berleur and Hollogne-aux-Pierres, and St. Walburge to Vottem.

Devon.—July 23rd. Wiring work at Devon County Asylum, 2,000 lamps, booster dynamo and motors, switchboard, and replating battery. See "Official Notices" June 27th.

Dresden.—October 1st. A competition for a safety apparatus in connection with the working of electric tramways will be decided on the date mentioned by the Communal Administration of the town of Dresden (Saxony). Three prizes of 5,000, 3,000 and 2,000 marks will be awarded.

Dublin.—July 29th. The Lighting Committee is inviting tenders for a cast-iron subway under the Grand Canal Dock for the electricity supply scheme.

Epsom.—July 18th. Semi-marine dry-back boiler, condensers, pumps, cooling pond, piping, one 150-KW. steam dynamo, switchgear, &c., for electricity works extensions. See "Official Notices" June 20th.

Farnworth.—July 31st. High speed engine and 250-KW. generator, switchboard, condenser, &c., for electricity works extensions. See "Official Notices" to-day.

Kala Lumpur (Selangor State).—August 21st. Two 600-H.P. turbines, two 400-KW. three-phase generators, switchboard, motor-generators, poles, wire, &c., for transmission line, arc and glow lamps, &c., for the Crown Agents for the Colonies. See "Official Notices" July 11th.

King William's Town (Cape Colony).—September 1st. Sealed tenders for electric lighting plant, &c, as per specifications, will be received at the office of the King Electric Lighting and Cold Storage Company, Limited, King William's Town, Cape Colony, until noon on Monday, September 1st, 1902. Mr. George Whitaker is the chairman of the company.

Launceston (Tasmania).—September 15th. The Corporation wants tenders for polyphase generating, transmitting, transforming and distributing apparatus, reconstructing existing plant, enclosed arc lamps, &c. See "Official Notices" May 23rd.

Leicester.—September 3rd. Tram rails, points, crossings, conduits, cables, overhead equipment, bonding, boilers, engines, generators, and other power station plant; also electric cars for the Corporation. See "Official Notices" to-day.

London, S.W.—July 31st. The War Office wants tenders for a self-propelled lorry (oil). See "Official Notices" April 25th.

Maidenhead.—July 25th. Wiring, fittings, &c., for the Municipal Technical Schools. See "Official Notices" to-day.

Malvern.—August 23rd. Lancashire boilers, engines, alternators, cables, transformers, switchboard, &c., for the Council's electricity supply scheme. See "Official Notices" July 11th.

Manchester.—July 22nd. Condensing pumps, tanks, piping, &c., for Stuart Street works. See "Official Notices" July 11th.

Mexborough.—July 19th. One 100-KW. steam dynamo for the U.D.C. See "Official Notices" July 4th.

Pemberton.—July 23rd. Cables for the U.D.C. See "Official Notices" July 4th.

Pontypridd.—July 31st. Cables and dust destructors for the U.D.C. See "Official Notices" July 4th.

Rochdale.—July 28th. Three tramcars with trucks, motors and equipment for the Corporation. See "Official Notices" to-day.

Servia.—August 13th. Tenders are being invited until August 13th by the municipal authorities of Nisch for the establishment of a central station for the electric lighting of the town.

Spain.—July 27th. Tenders are being invited until the 27th inst, by the municipal authorities of Azuaga (Badajoz province) for the concession for the electric lighting of the town during a period of 25 years. Tenders are to be sent to El Secretario del Ayuntamiento de Azuaga (Badajoz), whence particulars may be obtained.

Spain.—August 10th. The municipal authorities of Trujillo are inviting tenders until August 10th for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Trujillo.

St. Petersburg.—July 15/28. The Municipal Council is inviting tenders for the supply of telephonic apparatus, of which full particulars appear in our "Official Notices" July 11th.

Swindon.—July 29th. Complete installation of electric lighting at Workhouse and Infirmary. See "Official Notices" July 11th.

Swindon and Highworth Union.—July 29th. The Guardians want tenders for the installation of electric light at their Workhouse and Infirmary. Particulars from the consulting electrical engineer, Mr. G. R. Peers, Princes Chambers, John Dalton Street, Manchester.

Sydney.—July 23rd. Complete system of high and low pressure cables, and of arc lamps for street lighting, for the Municipal Council. See "Official Notices" June 13th.

Valparaiso.—September 1st. Construction and equipment of electric tramways. Further particulars from the Chilian Consulate.

CLOSED.

Ashton-under-Lyne.—The T.C. has accepted the tender of Messrs. Siemens Bros. & Co., Ltd., for the supply of electric light cables.

Burton-on-Trent.—Messrs. Willans & Robinson, Limited, have received an order through the B.T.H. Co., for three 180-H.P. engines for supplying power to the above.

Greenwich.—The B.C. has accepted the tender of Messrs. Rawlings Bros., of Blackheath, at £282, for the wiring and fitting of the Lecture Hall.

Huddersfield.—The Tramways Committee has accepted a quotation from Messrs. Miller & Co., of Edinburgh, for re-wheeling cars.

London.—In the lighting installation of the New Baltic sale rooms some 3,000 Premier electric incandescent lamps will be employed.

London.—The London County Council on Tuesday had under consideration the following tenders for the supply and erection of steam and other piping and valves, for the temporary power station at Bengeworth Road, Loughborough Junction:—

William Waterhouse, Limited (informal)	£2,035 9 4
Sir Hiram Maxim Electrical and Engineering Company (accepted)	2,268 7 0
British Mannesmann Tube Company	2,473 12 6
Aiton & Co.	2,500 17 0
Ashton, Frost & Co., Ltd. (incomplete)	2,600 0 0
Babcock & Wilcox, Ltd.	2,605 10 0
Meehan & Sons	2,700 0 0
Wenham & Waters, Ltd. (incomplete)	2,885 12 6
Cowlishaw, Walker & Co., Ltd. (informal)	2,910 0 0
D. Stewart & Co. Ltd.	2,945 0 0
Refuse Destructors, Ltd.	3,106 10 0
Light and Power Fittings Company	3,421 15 6

The company whose tender has been accepted has been authorised to sublet the steam pipework to A. J. Stewart & Menzies; the exhaust pipes to Clay, Henriques & Co.; the steam and feed valves to J. Hopkinson & Co.; the exhaust valves to Hamilton, Woods and Company; the expansion joint to Suffield & Brown; the joint rings to Newton & Nicholson; and non-conducting material to Jones and Horsfield.

Motherwell.—The Corporation has placed an order for a 500-KW. generator coupled to Willans engine, with the Lancashire Dynamo and Motor Company, Limited.

Rotherham.—The T.C. has accepted the following tenders for extensions to the electric tramway plant:—Messrs. W. T. Glover & Co., Limited, for feeders, &c., £6,726 1s. 6d.; Messrs. Hawksley, Wild & Co., Sheffield, for boilers, £1,770; Messrs. W. H. Allen, Son & Co., generating set, £2,721.

South America.—The Rosario Electric Lighting Company have just placed an order for three 360-H.P. Willans engines combined with dynamos by the A.E.G. Co.

Southampton.—The T.C. has resolved to accept the tender of the British Schuckert Electric Company, Limited, at £1,140, for the supply of a traction generator; and to dispose of the new alternator at a sum of £750, which has since been offered by Messrs. Ferranti for this machinery. During the year ending March 31st last, £2,424 had been contributed from the general district fund to the electrical department, and this reduced the deficit which stood at £4,476 to £1,638.

Swansea.—New cables for the Electrical Committee are to be supplied by Callender's Company.

Tynemouth.—The Corporation has ordered a motor for driving a condenser, from the Lancashire Dynamo and Motor Company, Limited.

Walsall.—The T.C. has accepted the tender of Mr. W. Harvey Gibbs, of King's Heath, Birmingham, for the erection of a tramway depôt for £7,450.

Wolverhampton.—The T.C. has accepted the tender of Messrs. Thomas Parker, Ltd., amounting to £198, for necessary extension to the 500-volt switchboard at the generating station.

FORTHCOMING EVENTS.

Saturday, July 19th.—At 3 p.m. Civil and Mechanical Engineers' Society. Visit to the Metropolitan Electric Supply Company's Works at Willesden.

NOTES.

Personal.—It will be remembered that recently the British Insulated Wire Company and the Telegraph Manufacturing Company combined forces. A general manager for the joint undertakings has now been appointed in the person of Mr. Dane Sinclair, the chief engineer of the National Telephone Company. We understand that Mr. Frank Gill, M.I.E.E., of Dublin, has been transferred to London by the N.T. Co. as Mr. Sinclair's successor.

Mr. A. Venning, late of the B.T.H. Co., has opened an office as consulting engineer at Sanctuary House, Tothill Street, Westminster. In view of the correspondence lately carried on in our columns, it may be of interest to know that Mr. Venning is an engineer who has had large experience at home and abroad. Commencing in 1875, he was articled to a firm of mining engineers in Cornwall, and on leaving them in 1880, joined the engineering staff of Messrs. Bolckow, Vaughan & Co., Middlesbrough, in the early days of the basic process of steel making. In September, 1882, he was engaged by Messrs. Crawshay, of South Wales, as assistant engineer in the reconstruction of their iron and steel works, remaining with them for seven years. He then went to America, and was at once engaged by the Edison Co., in New York, at the time when large central stations and direct-connected units were coming into use, taking a leading position in their steam engineering department. In January, 1893, Mr. Venning was appointed assistant mechanical engineer at the World's Fair, Chicago, and shortly after the close of the Exposition, was engaged by Messrs. Sargent & Lundy, of Chicago, who are well known in connection with several of the largest and most successful electrical installations in the States. Leaving this firm in 1897, he came to London as chief engineer of the central station department of the B.T.H. Co., since which time his work has become well known in this country. He recently resigned his position, and we are pleased to learn has made a successful start, being engaged by Mr. Clifton Robinson as consultant in carrying out the extensions of his generating station at Chiswick. We cordially wish him success.

Mr. V. O. Wandruszka has been appointed general manager and power house superintendent to the Hartlepool Electric Tramway Company, in place of Mr. Seed, resigned through ill-health.

Mr. W. Wilde, who has held a responsible position in the Bolton Corporation electric tramways department, has been presented with a costly gold chronograph watch and a travelling bag by the staff, on his departure for Cardiff.

Mr. Philip Dawson, M.Inst.E.E., is joining the firm of Kincaid, Waller & Manville, of 29, Great George Street, Westminster, and the firm will henceforth be known by the title of Kincaid, Waller, Manville & Dawson.

Mr. E. C. de Segundo has opened offices at Dashwood House, E.C., which he will make his headquarters, and to which letters should be addressed instead of to his Westminster office.

Cape Town Exhibition.—Mr. Albert P. Baker, the general manager of the British and Colonial Industrial Exhibition, which is to be held at Cape Town in November and December, 1903, and January and February, 1904, has sent us a few details regarding the arrangements which have been made for this important show. The idea to promote an exhibition is a most excellent one, and we hope and believe that representative manufacturers of this country will grasp this very admirable opportunity of showing their work. There is ample evidence forthcoming that Continental and American firms are making a bold bid for business in South Africa, and we must have as much as we can of the lion's share for British factories. We understand that all the necessary funds have been guaranteed, and that influential gentlemen have given their names as patrons, and at a later date the Chamber of Commerce and Town Council at Cape Town will appoint an advisory board. The site and buildings for the Exhibition will be situate at a most charming spot, only five minutes away from the Town Hall. Mr. Baker informs us that the Government railway companies have promised their support, and that the number of applications already received from various parts of the Empire are sufficient guarantee of its popularity and ultimate success. Mr. Baker's address is Seymour Grove, Manchester, and 30, St. George's Street, Cape Town. We have no doubt that British engineering and electrical manufacturing firms will deem this proposal as one worthy of their serious consideration, as a likely means of seconding their efforts to establish themselves on a substantial basis in the South African markets.

The Restriction of Output.—The *Times* of Wednesday contained the following interesting announcement:—"As the result of the discussion which followed the publication in *Times* of the series of articles on 'The Crisis in British Industry,' the United States Department of Labour is making an exhaustive inquiry into the whole question of restriction of output, as affecting not only Great Britain, but other countries as well. To this end the department has sent to England Prof. John H. Gray, of Chicago, who, from his headquarters at the First Avenue Hotel, Holborn, W.C., is inquiring among both employers and employed with a view to obtaining a full statement of facts in regard to restriction of output as practised in this country either by men or by masters. The Department of Labour has sent similar commissioners to Germany, France, and Belgium, and an investigation into the same subject is being carried on throughout the United States. When the information from the different countries has been duly collected, a report on it, giving the results of the inquiries, will be prepared by the Department of Labour, and this report will, it is expected, be published early next year."

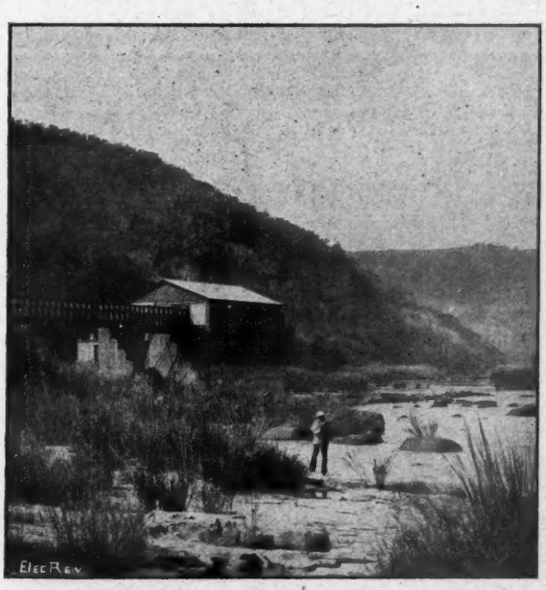
Marriages.—On July 2nd, at St. Mark's Church, Tollington Park, Mr. Arthur Percy Strohmenger, A.I.E.E., third son of Henry Strohmenger, Esq., of Tollington Place, N., was married to Matilda Justine, daughter of Adam Thumling, Esq., of Greek Street and Tollington Place.

Mr. J. E. Hodgkin, electrical engineer, and a director of Scott and Mountain, Limited, of Newcastle, was married to Miss E. L. Backhouse, at Darlington, on Tuesday last.

Cauvery Falls.—We read that on July 15th the Champion Reef Gold Mining Company of India received a cablegram from the mine to the effect that a portion of the Cauvery electrical machinery was successfully started on that day at Champion and Mysore. Those who wish to find some details respecting the Cauvery Falls electrical transmission scheme should refer to an article on "Electrical Development Schemes in India," which appeared in the ELECTRICAL REVIEW for November 2nd, 1900, p. 705.

The Canadian Arch Illumination.—When the report of the King's health continued to be so favourable, the Canadian Government decided not to disappoint the public, but to illuminate the large Triumphal Arch. Therefore on June 30th the London public were delighted to see for the first time a very brilliant illumination, executed chiefly with Nernst lamps. All the graceful and prominent lines of the Arch were covered with these lamps, each giving a very brilliant and dazzling white light of 160 to 180 C.P., the total number of lamps exceeding 350. We understand that notwithstanding this immense mass of light of about 60,000 candles the current consumed was exceedingly low, as each lamp did not consume more that 1 ampere on a 200-volt circuit, thus the average power required per candle was about 1·5 watts. Comparing this with the normal energy that the most economical incandescent lamp requires, it will be obvious to every one what great saving is obtained with the use of these Nernst lamps. The Arch was further illuminated with 24 arc lamps, each of about 1,000 C.P., eight of which were provided with red coloured globes, and also 750 small incandescent lamps of about 5 C.P., which were fitted on the lettering. All the different colours and shades of the various kinds of lamps gave an exceedingly pretty and effective result. Although the municipality had, in the first instance, great fear of permitting illumination of this very inflammable structure, which was standing between buildings containing very valuable property, there was not the slightest accident, owing to the precautions that the Electrical Company, Limited, had taken to prevent any mishap. This company at the present time is in communication with several electrical supply Corporations with a view to supplying these Nernst lamps for street-lighting purposes.

Electrical Transmission for a Natal Tea Factory.—The accompanying illustration shows the building recently erected on the River Umvoti, in Natal, for transmitting electrical power to the tea factory of Messrs. J. L. Hulett & Sons, Limited, on the famous Kearsney Estate, between three and four miles away. The electrical plant, which was supplied by Messrs. Siemens Bros., Ltd., was erected at a cost of £8,000, and, for its size, is as complete as any



Power House on the River Umvoti.

to be found elsewhere in South Africa. The lands held by the company—of which Sir James Liege Hulett, Speaker, Natal Legislative Assembly, is the head—total 19,269 acres, of which 1,400 acres are under tea and 500 acres under sugar-cane. Last year the tea output was 1,000 lbs. short of 1,000,000 lbs. We understand that the company propose ultimately to employ electricity as the motive power of their newly-erected sugar factory.

The Question of Depreciation.—The discussion at the Wolverhampton Town Council meeting, which we briefly report elsewhere, seems to indicate that the Councillors are waking up to their true position, which is clear enough to those who are not blinded by unwillingness to see. It must be conceded that, generally speaking, electrical plant cannot have a useful life of much more than 30 years, the duration of the loans. Hence new plant will be necessary after that period. In the absence of a depreciation fund, new loans must be raised to pay for it, and must be paid off during the *next* 30 years. Now, we are told—or, rather, the ratepayers are told—that after the loans have been paid off, the community will possess a highly profitable property. But when will those loans be paid off? Clearly, never! For no sooner does one terminate than another has to be raised! It is idle to speak of the small sums which sometimes remain, as "net profits"; they are not worth considering in comparison with the total rates levied upon the communities concerned. Where real assistance to the rates has been given, Nemesis has not tarried far behind—it is soon found that such payments are misapplied, and ought to have been devoted to the formation of a substantial reserve fund. It is evident, then, that these "large profits" cannot be realised while the loans are being paid off. As we have shown, the loans never will be (finally) paid off; and, to be perfectly explicit, those large profits never will be realised. The laboured explanations of the usual deficit would be amusing if they were not so pathetic.

Tramway Managers.—A number of members of the Association of Municipal Tramways Managers of Great Britain visited, on 4th inst., the power stations of the Central London Railway and the L.U.T. The company included:—Mr. John Young, of Glasgow (President of the Association), Mr. J. M. McElroy, of Manchester (secretary), Messrs. C. R. Bellamy (Liverpool), E. Ha'ton (Salford), Gordon (Dublin), Pitt-Cairn (Edinburgh), A. L. C. Fell (Sheffield), F. Spencer (Halifax). At Chiswick, Mr. J. Clifton Robinson told the visitors that he considered that London needed about 2,000 miles of tramways.

Pacific Cable Scheme.—The Telegraph Construction and Maintenance Company's new vessel *Colonia* left Margate Roads on Saturday last, loaded with some 3,550 nauts of heavy cored cable (core 650/400 lbs.) for the long section of the All-British Pacific Cable scheme. This is the record length of cable ever taken by one vessel. The *Colonia* proceeds to the Pacific *viâ* the Suez Canal.

It is reported that upon the completion of communication between Vancouver and Australia, the laying of a link cable to connect Fanning Island with Honolulu is contemplated. This will connect together the All-British and the Commercial Pacific cables, and will afford an alternative and inexpensive route to both.

Novel Electric Lighting Installation.—We have been given to understand that the electric light is the poor man's light; it would appear, from the following extract from an East Anglian paper, that the fowls of the air participate in the enjoyment of its beneficent illumination:—"The application of the Summer Entertainments Syndicate for the lighting of the Sparrow's Nest was considered, and the engineer was instructed, provided the syndicate will light the Sparrow's Nest with electric light on the six fête nights, and use the light for the ordinary stage lighting, to fix up about 30 lamps in the back baths, and light same." Obviously, this has nothing to do with the Pigeon House Electricity Works, and it occurs in the proceedings of a municipal Council, so that to suggest a mare's nest would be most inappropriate.

Wireless Telegraphy Again.—The daily papers of Wednesday last contained one of the "wireless" announcements of the kind to which the world is now becoming used, if not indifferent. This time we learn of signals having been successfully transmitted from England to Denmark. In the continued dearth of tangible results, something more exciting than this begins to be required.

How about the trans-Atlantic service which we were promised, but as regards the establishment of which no definite date can now be given by its sponsors, *vide* the *St. James's Gazette* of Wednesday last? Is the present announcement of the Danish experiment made with the view of diverting public attention from the unexplained delay which has taken place in establishing the promised communication across the North Atlantic?—what is the cause of this delay?

In the *Times* of the 15th inst., appears a "belated" letter from one panegyrist of wireless telegraphy, who hitherto has not shone conspicuously as a public controversialist, which letter was answered in their issue of the following day. In view of this reply to his letter, and under all the circumstances, Mr. H. Heaton may, or may not, feel that it would have been better for the inventor whom he champions, and better for those whose interests he attempts to serve, had he, in this matter, held his peace. According to Mr. Heaton, wireless telegraphy lifts man "a little nearer to the angels," and he promises us a service to New Zealand at 6d. a word. Doubtless, in time, some equally unselfish politician and reformer will arise who, in a laudable desire to bring man still nearer to the angels, will not rest content until the said service, when established, has been reduced to a penny, or made gratuitous. "Nearer to the angels" is distinctly good, however, as a rallying cry to the weary investor, for those with whose wireless ventures Mr. Heaton has associated himself. But, to come to business, before the interesting transmission of S S S in the Morse code alphabet to New Zealand, may we not have an intelligible word or two from or with the North American seaboard?

Wittings' Works Negotiations Off.—Our Huddersfield correspondent writes that the negotiations with an important firm of electrical engineers at Prague, Austria (for whom Messrs. Witting Bros., of London, are the English agents), with the view of establishing, with the assistance of local capital, a similar industry at Huddersfield, have fallen through. A deputation of Huddersfield capitalists recently visited Prague, and favourably reported, but, in the later discussions, unsuccessful overtures were made by Messrs. Witting Bros. with the object of joining in the proposed new concern with an increased capital.

Tube Railways.—The eight tube railway schemes, over which a good deal of discussion has arisen in the *Times* during the past week, came before the House of Commons on Wednesday, and passed the second reading stage. They will be referred to Select Committee.

The Temperature of the Exhaust of a Gas Engine.—The difficulties encountered in finding the true exhaust temperature of a gas engine are great, and induced Mr. R. H. Fernand to devise a practical method, which he has described in a paper before the American Society of Mechanical Engineers. He practically constructs a vessel that will allow the gases to expand down to atmospheric pressure, and he determines the temperature at that pressure, taking care that his vessel allows no indraught of cold air. His receiver is built of bricks laid loosely, with the inner bricks flat and the outer ones on edge. Then calling H the actual terminal pressure, and A the atmospheric pressure, and T the absolute temperature found in the receiver at atmospheric pressure, he finds the exhaust temperature, proportional, of course, to the absolute pressures, to be $t = T \times \frac{H}{A}$. Thus, where H was 40 lbs., and A, of course, 14·7, T was found to be 629° absolute. Hence $t = 1{,}800°$ absolute, or 1,341° F., temperatures much higher than often supposed.

Holidays.—Messrs. Willans & Robinson, Limited, of Rugby, will close their works from Saturday, August 2nd, to Monday, 11th, for the annual holiday, but, of course, a staff will remain to deal with urgent correspondence. No doubt, as this period includes Bank Holiday and Coronation Day, various other manufacturers will adopt a similar plan.

Appointments Vacant.—Two shift engineers for Leith; electrical engineer for Tonbridge, at £150; assistant engineer for Portsmouth Electricity Works, £100.

THE CENTRAL STATION ENGINEER.

On Saturday, July 5th, the employés of the Paisley Corporation electricity works held their second picnic in an enjoyable manner at Rothesay. Dinner was served at the Norman Institute, after which the party proceeded in char-a-bancs to Ettrick Bay, where sports were held on the sands. After the sports the party returned to Rothesay, and sat down to tea in the Norman Institute. The remainder of the evening was spent in the usual way until time for the last steamer for Gourock. The convener of the Electric Lighting Committee, and the chief engineer, Mr. C. F. Parkinson, were the guests of the company.

Mr. H. Collings Bishop, of Wigan, has been appointed borough electrical engineer and tramways manager at Newport (Mon.) at a salary of £500 per annum.

Mr. Ritson, engineer of the Kendal Corporation electric light and gas works, has resigned his position, owing to his acceptance of the post of borough engineer at Ramsgate.

The Darlington E.L. and Tramway Committee has decided to increase the salary of the engineer, Mr. J. R. P. Lunn, by £50 a year.

On the occasion of his marriage, Mr. W. E. Preston, clerk in the electricity and tramways department, was presented by Mr. Stewart, assistant, on behalf of the staff, with a handsome carved oak timepiece.

CITY NOTES.

Electric Construction Company.

Mr. J. W. Barclay (chairman) presided on Thursday morning at Winchester House, Old Broad Street, over the ninth annual general meeting of the above company, and in moving the adoption of the report, said that before addressing himself to the business of this meeting, he desired, on behalf of his colleagues and himself, to express their deep sense of the great loss the company had sustained in the death of their much-esteemed and valued chairman, Sir Daniel Cooper, and they felt it to be their duty, as it was their privilege, to acknowledge with gratitude and thanks his great and long-continued services to the company. The directors had much satisfaction in submitting to them their yearly report and accounts. The net profit of the year was £20,496 19s. 11d., but to this had to be added the balance brought into the account from last year, £2,853 18s. 2d., and the total available for distribution was thus brought up to £23,350 18s. 1d. This sum it was proposed to appropriate in payment of the fixed dividend on the preference and of 6 per cent. on the ordinary shares, and in adding £2,000 to the general reserve—the balance of £3,504 6s. 1d. being carried forward to the credit of next year's profit and loss account. The general results of the year's business were similar to those of last year, and coupled with the figures of previous years went to show that they had a steady-going business, while at the same time their position from year to year became more firmly established. No doubt they noted that their general reserve was now £32,000, while the depreciation fund, made up exclusively from revenue amounted to £43,000. This was the ninth annual report, and if they went on accumulating at the same rate for another nine years, the company would be in a very comfortable position indeed. He had much satisfaction in referring to the handsome increase in the net receipts from the Madras Tramways; it is no less than 33 per cent. over that of last year, and the gross receipts for 1902 so far showed every promise of even a larger increase in the current year. There was thus great promise that this will prove a highly profitable undertaking, but, as he told them on a previous occasion, they intended to restrict themselves to the manufacturing business, and would, therefore, avail themselves of a favourable opportunity, which they looked for soon to dispose of the tramways in whole or in part. The shares of other companies consisted almost entirely of holdings in the Electrical Power Storage Company and in the Crystal Palace District Electric Supply Company. They might recollect that the Electrical Power Storage Company was a subsidiary company formed to take over the accumulator branch of the old company's business. The Storage Company had under the present able management proved a success, for it held the premier position among electric storage companies. The development of electric traction was opening up a great future for such manufactures, and he was glad to say that the profits of the company showed a large increase in the year just ended. The expenditure side of the account showed increases in some items, but these were of an exceptional character, and a considerable reduction in expenses was anticipated during the current year. Their managing director (Mr. Gray) maintained a close supervision of all outlays, and saw that they got full value for their money. He was glad to inform them that the compensation for accidents to workmen during the year was only £36 13s. 3d., which was less than one-fourth of what they would have to pay an insurance company for the risk. This seemed a very good test of the skill and carefulness of the men. He did not know whether many of them had been to the Wolverhampton Exhibition, but if so, he was sure they would be well satisfied with the display of electrical plant made by the company, and he could assure them that the machines were quite as effective as they looked, for he was told they provided a large share of the power required by the Exhibition, and actually supplied the whole on the day the Exhibition was opened. The relations between the management and all classes of the employés continued to be thoroughly cordial, and the directors had much satisfaction in recommending the distribution among them of the usual bonus in token of their appreciation of steady and zealous service. This bonus was determined by the rate of dividend, the wages paid to each man, and his industry and regularity during the year. They believed the money was well spent. It encouraged the men to steady industry, interested them in the prosperity of the company, and tended to the growth of confidence between employer and employed. Competition between the manufacturers of electrical machinery had been and still was very keen, but they maintained their position. Their works, plant and tools were all modern and of the best, and in size capable of turning out the largest machines that might be required. They had reason to be satisfied with the ability of the staff and the skill and industry of their artisans, who recognised that if they were to earn a bonus they must do, at least, as well as others. So, fully equipped in every respect, he thought they had every reason to have confidence in the future of the company. They did a safe, non-speculative business, and might have confidence that in the future, as in the past, they would have a fair share of what success was going in the manufacturing world.

Sir H. C. Mance seconded the motion.

Replying to questions, the Chairman stated that the increase of £5,000 in regard to the cost of the Madras Tramways was due to the increase in the rolling stock owing to the increase in the traffic. The additional £10,000 with regard to loans was owing to a temporary loan being obtained before they sold the debentures in the market.

The report was adopted unanimously.

Electrical Power Storage Company, Ltd.

Mr. J. I. Courtenay (chairman) presided over the meeting of this company on Thursday last week at 4, Great Winchester Street, E.C., and in moving the adoption of the report, said that the net profit for the year was £10,913 13s. 8d., making, with the balance brought forward, £11,346 2s. 9d. Out of this sum they had transferred £5,000 to reserve, and £1,000 to contingent fund, and recommended a dividend of 5 per cent. upon the ordinary capital. The reserve would now stand at £15,000, and the contingent fund at £5,000. They believed shareholders would approve of this cautious policy, which would greatly strengthen the position of the company. The steady increase in the contingent fund also must, they felt certain, convince customers of the company's ability to fulfil its obligations under the maintenance contracts. The factory had been maintained in thorough repair and condition at a cost of £2,102 18s. 3d., and £956 17s. 7d. written off for depreciation. The works were furnished with the latest types of labour-saving machinery. Owing to the continually increasing demand for cells of the larger central station types, a contract had been entered into for the erection of an additional floor in the main building of the factory, which, when completed, would enable them to substantially reduce the time necessary for delivery. The year had been an exceptionally prosperous one for the company. This was due to a general increase of business in all directions; orders for lighting and power stations, for private installations, and for traction purposes all showing an increase over previous years. They were able to start the new financial year with orders ahead to an amount which was considerably in excess of that of any previous year. The chairman proceeded to mention some of the larger contracts completed during the year. They were still continuing their experiments with batteries for electric traction, and although their laboratory had tested a very large number of cells manufactured in this country, on the Conti-

nent, and also in America, they had not yet found anything which was superior to the cell they were now manufacturing and selling in large quantities to the City and Suburban Electric Carriage Company, who were doing a considerable business in electrically-propelled vehicles. He might say, further, that the results which they had obtained from experiments with their own vehicles specially kept for experimental use, pointed to the fact that the supply and maintenance of batteries for these vehicles was not nearly so expensive as the public imagined, and they had now a project under consideration which would enable the purchasers of vehicles to hire batteries at a very reasonable rate. For the last two years there had been more or less persistent rumours of an accumulator invented by Mr. Edison, which would, they were told, revolutionise electric traction. Mr. Edison was undoubtedly an exceedingly able man, and the science of electricity owed much to him, but he could assure the shareholders that it was quite too early to place reliance on statements which, in many instances, bore on the surface evidence that they were circulated by irresponsible parties, and did not emanate from the inventor. Although they had followed Mr. Edison's figures closely, they could not find that even his own statements showed that he was able to make a battery which was more than 10 per cent. lighter than the special battery they manufactured for traction purposes, and as Mr. Edison's battery must be at least two or three times as expensive to manufacture as their own, it would have to last a very long time indeed if it was to come into competition with those which they were now selling. If, moreover, they judged from their own laboratory experience and the experience of their technical staff, they thought it might probably be found that Mr. Edison was still far from being in a position to make a commercial article of his invention. The experience of the E.P.S. Company, extending over 20 years, showed that there had been no radical alteration in principle resulting in a signal commercial success since Camille A. Faure introduced the mechanical application of a salt of lead to the lead grid or support. It must not be forgotten that the excellent results of the year's working which they had before them had been obtained in the teeth of the severest competition, and it was largely due to the gradual improvement in detail made by the staff and works that they were able now to compete so successfully, both in regard to price and quality. The company had never been tempted to enter into what he might justly call a ruinous competition, that was, to sell a cheap article which would, in the long run, bring discredit on the company. In furtherance of their continual improvement in detail, they were now introducing a new form of negative plate, under the name of "Carzonode," which, after exhaustive tests extending over three to four years, they found was vastly superior to those at present in use, and would enable the company eventually to materially reduce their maintenance rates, thus increasing their power of meeting a certain class of competition, which, in the past, they had felt somewhat severe. In conclusion, the chairman referred with deep regret to the recent death of Sir Daniel Cooper, Bart., G.C.M.G., one of the original directors.

Sir James Pender, Bart., seconded the motion, and Mr. Barclay made some congratulatory remarks.

The Chairman, in reply, said that on an average they had a new accumulator submitted to them every week, and these were thoroughly tested.

The report was adopted unanimously.

Ottawa Electric Company.

In their eighth annual report the directors say that the completion of the new power house with its more modern system of generating and distributing electric energy has enabled the management to effect the contemplated economies with most pleasing results, notwithstanding that it was only possible to put the majority of such economies into full effect during the latter half of the year, dating from the opening of the new power house on November 16th last. The company's operations for the past year show a gross revenue from all sources of $227,634.83, being an increase of $31,271.61 over the previous year, after making liberal provision for bad and doubtful debts. The gross cost of operating and maintenance was $115,244.02, leaving a profit of $112,390.81, from which profit is deducted $25,913.38 for interest paid upon bonds and current liabilities, leaving the net profit $86,477.43. The percentage of maintenance and operation to gross receipts was practically 50 per cent. An amount of $75,000 has been carried to depreciation account, to provide for wear and tear and general depreciation of plant. The directors are satisfied that the company is now in such a satisfactory condition that the resumption of the payment of a dividend is assured for the current year.

Prospectuses.

The list of subscriptions was closed on Wednesday in an issue of 75,000 5 per cent. cumulative preference shares of £1 each and 100,000 preferred ordinary shares in the Bath Electric Tramways, Limited. The company has a nominal capital of £230,000, divided into 75,000 5 per cent. cum. pref. shares of £1 each, 125,000 preferred ordinary shares of £1 each, and 30,000 deferred ordinary shares of £1 each, and has been formed for the purpose of constructing a complete system of electrical tramway and light railways, also undertaking other electrical business in the city of Bath and the surrounding district.

It is stated that the prospectus of the Yorkshire Electric Power Company is to be out in a week or two.

The *Financial News*, in a critical note, says that the prospectus of the British Griffin Chilled Iron and Steel Company, Limited, is in private circulation, offering 38,433 shares to the public, and reserving the right to go to allotment if they get 100 shares subscribed for!

Telegraph Construction and Maintenance Company.

Sir Robert G. W. Herbert presided at the half-yearly meeting held at the offices on Tuesday, and stated that the interim dividend at the rate of 5 per cent. was available and would be paid. They had had a busy six months, and a great amount of cable had been constructed and shipped. From the *Times* report we learn that on Saturday last their new ship *Colonia* sailed for Vancouver with 3,500 knots—which was a long stretch of cable—to connect Vancouver and Fanning Island. As the shareholders were aware, the *Colonia* was the largest cable ship in the world. She could carry 11,000 tons of dead-weight, she was 500 ft. long, and she could carry 4,000 knots of cable. On her trial trip she steamed as much as 14½ knots. She was, therefore, a very efficient vessel, and the directors looked forward with sanguine expectations to the results of her present difficult work. The *Anglia* had returned to England, having laid the shorter portions of the line connecting Vancouver with Australia and New Zealand. She went through a severe cyclone, but behaved in a highly satisfactory manner. The company were hard at work, and were still constructing some portion of the Pacific cable. The entire work would be completed before the expiration of the period in which they undertook to finish it. The whole of the cable connecting Canada with Australia and New Zealand had to be completed before the end of the year, and they would be more than ready with the work when that period arrived. The company had smaller labours on hand to execute than the Pacific cable, such as providing lengths of cable by way of repairs and occasional breakdowns for various companies, and the directors expected that the company would be well employed until the annual meeting.

Oesterreichische Gasgluhlicht und Elektricitäts Gesellschaft.

The report of this company for the year ending March 31st, states that after deduction of expenses and taxes, the total profit was £53,594, being a reduction of £26,679 on the previous year. A moiety of the French, Spanish and Portuguese patent rights of the Osmium electric lamp have been sold for about £40,000, which has been written off the patent account. A total dividend of 40 per cent. has been paid on the "A" shares for the year.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—Isle of Thanet Electric Tramways and Lighting Company, Limited—£150,000 4 per cent. debenture stock; and to allow the following securities to be quoted in the Official List:—Edmundson's Electricity Corporation, Limited—further issue of 10,000 ordinary shares of £5 each, fully paid, Nos. 40,001 to 50,000, and 4,500 ordinary shares of £5 each, fully paid; London United Tramways (1901), Limited—60,000 ordinary shares of £10 each, fully paid, Nos. 8 to 60,007.

St. James' and Pall Mall Electric Light Company.—The directors have declared the following interim dividends for the half-year ended June 30th:—At the rate of 7 per cent. per annum on the preference shares, and at the rate of 10 per cent. per annum on the ordinary shares.

National Telephone Company.—The directors have resolved, subject to final audit, to recommend at the forthcoming general meeting of the shareholders the following dividends for the half-year ending June 30th last:—

At the rate of 6 per cent. per annum on the first and second preference shares; at the rate of 5 per cent. per annum on the third preference shares; at the rate of 6 per cent. per annum on the preferred stock, and at the rate of 4½ per cent. per annum on the deferred stock, being equivalent to 5 per cent. per annum on the ordinary shares now divided into preferred and deferred stocks, less income-tax in all cases, carrying £70,000 to reserve, and about £3,000 forward.

City and South London Railway Company.—The accounts for the half-year ended June 30th show a balance, after providing for the debenture stock interest, the payment of the dividend on the preference stocks, and the transfer to the renewal fund of £2,000, sufficient to allow the payment of a dividend on the consolidated ordinary stock for the half-year at the rate of 3 per cent. per annum, carrying forward a balance of £1,750. The dividend for the corresponding period last year was at the rate of 1¾ per cent. per annum, carrying forward a balance of £733.

Crompton & Co., Limited.—The directors have decided, subject to audit, to recommend the payment of a dividend at the rate of 6 per cent. per annum for the half-year ended March 31st last.

Globe Telegraph and Trust Company.—The directors announce a final dividend of 4s. 9d. per share on the ordinary shares, making a total distribution for the year of 5⅜ per cent.

Direct United States Cable Co.—The board has resolved to recommend a final dividend of 3s. per share and a bonus of 1s. per share, making with the three interim dividends already paid a total distribution of 3½ per cent. for the year ended June 30th last, and after placing £5,000 to reserve fund account, carrying forward a balance of about £2,196.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—Week ending July 11th, £860; last year, £742; increase, £118. Total from March 25th, £12,981; last year, £10,793; increase, £2,138.

Blackpool and Fleetwood Tramways.—Week ending July 12th, £714; last year, £1,042; decrease, £328. Total to date, £1,171; last year, £1,827; decrease, £656.

Bristol Tramways and Carriage Company.—Week ending July 11th, £5,151; last year, £5,065; increase, £86.

British Electric Traction Company.—The following returns are issued of the undertakings of this company for the week ending July 4th:—

Company.	Amount	Comparison with corresponding week of last year.		No. of weeks.	Aggregate.		
					Amount.	Inc. or Dec.	
	£	+ £	− £		£	+ £	− £
Devonport*	465	133	—	26½	10,810	184	—
Dudley—Stourbridge	786	56	—	26½	18,604	2,693	—
Gateshead¶	606	260	—	26½	18,326	2,476	—
Greenock-Pt. Glasgow	658	594	—	26½	19,144	7,134	—
Hartlepool	315	44	—	26½	6,112	686	—
Kidderminster ..	166	—	20	26½	2,986	57	—
Merthyr†	223	—	18	26½	5,324	—	666
Middleton*	334	—	—	14½	4,543	—	—
Oldham—Ashton ..	587	56	—	26½	18,402	432	—
Poole†	298	20	—	26½	6,043	—	66
Potteries	1,689	—	71	26½	38,039	1,497	—
Southport	862	904	—	26½	5,831	1,984	—
South Staffordshire†	810	—	22	26½	20,315	728	—
Swansea	583	111	—	26½	11,975	1,403	—
Taunton*	71	—	—	26½	1,580	—	—
Tynemouth‡	394	60	—	26½	6,892	539	—
Wolverhampton Dist.	157	100	—	26½	3,846	2,479	—

* Not in operation last year. † Partly steam. ‡ Comparison from April 5th only. ‖ Comparison from March 18th only. ¶ Comparison from May 8th only. ** Comparison from June 26th only.

Central London Railway.—Week ending July 12th, £6,847; last year, £6,145; increase, £702. Total to date, £14,043; last year, £12,224; increase, £1,819. Miles open, 6.

City and South London Railway.—Week ending July 13th, £2,786; last year, £1,872; increase, £914. Total to date (2 weeks), £5,567; last year, £3,844; increase, £1,763. Miles open, 6½; last year, 4½.

Dover Corporation Tramways.—Week ending July 12th, £269 9s. 10d½.; last year, £274 10s. 10d.; decrease, £5 0s. 1½d. Total to date, £5,583 10s. 8½d.; last year, £5,882 17s. 1d.; increase, £200 13s. 2½d. Miles open, 3. Car miles run, 5,264; last year, 5,222. Number of cars, 11.

Dublin United Tramways Company.—Three days ending July 11th:—D.U.T. Co., £4,051 5s. 3d.; D.S.D. Co., £1,151 16s. 6d.; total, £5,203 1s. 3d. Last year—D.U.T. Co., £4,171 12s. 9d.; D.S.D. Co., £1,105 1s. 9d.; total, £5,277 15s. 6d.; decrease, £174 14s. 3d. Aggregate to date, £8,013 13s. 3d.; last year, £8,228 5s. 1d.; decrease, £209 11s. 10d. Mileage worked, 46.

East Ham Tramways.—Week ending July 12th, £506 17s. 11d.; last year, £472 9s. 4d.; increase, £34 8s. 7d. Total to date (three weeks), £1,682 17s. 4d.; last year (three weeks), £1,411 8s. 4d.; increase, £271 9s. Miles of track open, 5½. Car miles run, 11,542; last year, 7,241. Number of cars, 20; last year, 14.

Glasgow Corporation Tramways.—Week ending July 12th, £11,125 7s. 3d.; last year, £12,952 4s. 1d.; decrease, £1,826 16s. 10d. Total to date, £72,221 13s. 7d.; last year, £74,582 5s. 9d.; decrease, £2,360 12s. 2d. Miles of track open (double), 55; last year, 44½. Car miles run, 250,740; last year, 236,374. Decrease due to holidays last year. This year they commence a week later.

Liverpool Overhead Railway.—Week ending July 13th, £1,584; last year, £1,765; decrease, £181. Total to date, from January 1st, £3,179; last year, £3,497; decrease, £318. Miles open, 6 miles 57 chains.

Sunderland Corporation Tramways.—Week ending July 13th, £1,190; last year, £1,287; decrease, £97. Total to date (15 weeks), £17,399; last year, £15,692; increase, £1,707.

STOCKS AND SHARES.

Wednesday Evening.

The resignations of Lord Salisbury and Sir M. Hicks-Beach, did not make any difference to markets, in fact, Consols closed better on the day. Business all round is showing signs of easing down, members taking advantage of a nineteen-day account to have a long holiday, whilst again many have extended the Henley "week" until next account day. It is a well-known superstition that a nineteen-days' account is always an unsatisfactory one. The few failures announced were only small, and did not affect the Kaffir market, except, perhaps, in one or two cases. The settling of last account was not an onerous matter, and although the present one is two days longer, it is not likely to make itself felt when pay day comes. Home Rails have been rather neglected, but Yankees have exhibited strength. Central London Deferred stock has lost 1 point at 103—106, and City and South London Ordinary stock has fallen £2 to 72—74, in spite of the increase in the dividend to 3 per cent. Waterloo and City Ordinary stock is also a little "off colour" at 92—5, a shrinkage of 1 point.

In the electrical supply list only a few alterations are to be noted, which are more or less of an unimportant nature. Brompton on offer at 9—9½ do not move, whilst in Charing Cross issues no variations have to be recorded. Citys have hardened ⅛ to 8½—9½ without bringing any business, whilst in the 5 per cent. Debenture a little trade has been passing, resulting in a rise of 1 per cent. to 122—127. The 4½ per cent. Debenture has yielded its rise of last week, and closes steady at 101—104. Kensington, Londons and Metropolitans are all neglected. Notting Hills are quoted ½ lower at 13½—14½, which is only reflecting the amount of the dividend deducted. Like the Brompton Company, the St. James interim dividend is at the same rate as last year, namely, 10 per cent. South Londons and Westminsters are both down on the week, but keep steady at their present prices.

In view of the fact of having mentioned last week the excellent report of the Edmundson Company, we give below some figures of interest of the past four years:—

Year ended	Net profits. £	Income from investments included in the net profits. £	Dividend paid on ordinary shares.	Carried to reserve. £
March, 1899 ..	11,704	Nil.	6 per cent.	Nil.
,, 1900 ..	20,876	4,438	6 ,,	Nil.
,, 1901 ..	27,294	11,108	7 ,,	4,000
,, 1902 ..	37,180	12,756	7 ,,	10,000

By the way, the small number of Deferred shares which were in existence have now been converted according to the terms of the articles of association, into Ordinary shares.

The Traction market has been fairly active, considering other departments in the "House," and the usual number of changes have taken place. British Aluminium Preference and Debenture are very dull, the former losing ½ at 4—5, and the latter being 3 per cent. down at 83—88. British Electric Traction Ordinary show no quotable change, although they are slightly harder. The Preference keeps steady at 12—12½. A good deal of business has been doing in both these issues, and an improvement in the prices would not come as a surprise. It is interesting to note that Mr. W. L. Madgen has been made a director of this company. British Insulated Wire Ordinary are always a risky market to deal in, but the shares have kept a little steadier this week and close unchanged at 7½—8½. Brush Ordinary and Preference are firm, dealings being registered at current quotations. Callender Cables are *ex* the bonus of 5s. at 15½—16½. Cromptons have shed ¼ at 2⅞—3¼, at which price one or two bargains were done.

Edison 4 per cent. and 5 per cent. Debentures are the turn easier, although the shares have not moved. The market in these securities is so rotten that a small bargain either way is sufficient to alter the price to almost any extent. Electric Construction Ordinary are firmer at 1¼—1⅜ *ex* dividend, with not much business doing in them. The Preference and Debenture are quiet at current quotations. General Electric Preference at 9¾—10¼ have hardly been mentioned. The Debenture has been done at 99—101. Henley's and India-rubbers are unaltered from last week's prices. Telegraph Construction 4 per cent. Debenture is one point better at 102—105.

London United Tramways Debenture continues to be eagerly sought after, and closes 2 per cent. higher at 107—109. It is worthy of note that when this stock was first put on the market at 100, investors were shy to touch it; now that it commands 8 premium the supply is inadequate to the demand.

As regards the Welsbach report, the general opinion in the market seems to be that there is "more in it than meets the eye." A careful perusal of the document will show one or two items on the debit side which will not appear next year, and had these been knocked out, the profits, instead of being only £23,000, would have been nearer £50,000. Of course, compared with three or four years ago, the whole showing is deplorable.

Like other concerns of a similar nature, the Bath Electric Tramways, Limited, has a long time to look forward to before the real tramway work begins, and those applying for shares must have a cast-iron patience to back them up.

The telegraph market has kept pretty steady all round, with only a few alterations to mention. The dividend of 3½ per cent. on Direct United States Cable did not affect the price, which remains 10—11. Eastern Telegraph 3½ per cent. Preference stock is *ex* the quarterly dividend, but the price remains 88—91. The 4 per cent. Debenture is one point better, at 108—112. The Eastern Extension 4 per cent. Debenture has risen 1 per cent., and closes firm at 109—114. Globe Telegraphs mark an advance of ½, at 8½—9½ on the small increase in the dividend over last year. The distribution is 4s. 9d. per share, making 5⅜ per cent. for the year, with a carry forward of about £18,000. In spite of the disastrous fire in London Wall, National Telephones maintain their prices, whilst the Deferred stock is up 1 per cent., as is also the 3½ per cent. Debenture at 94—97. Western Telegraphs 4 per cent. Debenture shows a rise of £1, at 98—101; on the other hand, West India and Panama 5 per cent. Debentures have receded to 99—102.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotations July 9th.	Closing Quotation July 16th.	Business done during week ended July 16th, 1902. Highest.	Lowest
£2,300	African Direct Telegraph, 4 % Debs.	100	...	...	...	98 —102	98 —102	...	...
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	...	...	...	3⅛— 4⅛	3⅛— 4⅛	4 1/16	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	70 — 80	70 — 80	...	...
804,720	Anglo-American Telegraph	Stock	7⅜	3½ %	6⅛.	46 — 49	46 — 49	...	...
3,097,640	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	90 — 92	90 — 92	92	90½
3,097,640	Do. do. Deferred	Stock	£1 7s.	5s. %	2s.	7 — 7⅛	6⅞— 7⅛	7⅛	7 1/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	5%	3⅜— 4⅛	3⅜— 4⅛	4 1/16	4
12,983,300$	Commercial Cable	$100	8 %	...	...	165 —170	165 —170	...	...
1,741,629£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	95 — 97	95 — 97	96⅛	95⅛
16,000	Cuba Telegraph	10	7 %	...	...	4½— 5½	4½— 5½	...	...
6,000	Do. 10 % Pref.	10	...	...	...	12½— 13½	12½— 13½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	2½— 3½	2½— 3½	2⅜	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	7½— 8½	7½— 8½	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	100 —103	99 —102 xd	...	...
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10 — 11	10 — 11	10½	10
96,300	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	120 —130	120 —130	124	121½
1,930,807	Do. 3½ % Pref. Stock	100	...	...	...	88 — 91	88 — 91	89½	88
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	107 —111	107 —111	109	...
300,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12 — 13	12 — 13	12 5/16	12 1/16
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	108 —113	108 —113	112	111½
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	5½%	...	...	100 —103	100 —103	101½	100
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103	100 —103	...	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	...	8 — 9	8½— 9½	9⅛	8⅞
180,042	Do. do. 6 % Pref.	10	...	...	...	12½— 13½	12½— 13½	13⅛	13
150,000	Great Northern Telegraph, of Copenhagen	10	...	15 %	...	25 — 27	25 — 27	26⅛	26⅛
70,000	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	37 — 41	37 — 41	...	...
180,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	100 —104	100 —104	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680	1	2½%	...	...	⅛— ¼	⅛— ¼	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	...	...	¾— 1	¾— 1	...	..
983,333	National Telephone, Pref. Stock	100	5 %	5 %	5 %	95 — 99	95 — 99	97½	95
200,000	Do Pref. shares	2	...	3½	3⅜	4⅜— 4⅞	4⅜— 4⅞	...	...
1,966,667	Do Def. Stock	100	...	60	64 xd	54 — 58	55 — 59	56	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	13⅜	13½
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4½— 5⅛	4⅞— 5⅛	...	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	93 — 96	94 — 97	96	94
500,000£	Do. 4 % Deb. Stock Red.	100	...	4 %	4 %	102 —106	102 —106	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	6 %	6 %	1/16— 1 1/16	1/16— 1 1/16	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's	8	5 %	5 %	...	6½— 7½	6½— 7½	...	...
3,303	Submarine Cables Trust	Cert.	...	...	...	110 —120	110 —120	...	...
58,000	United River Plate Telephone	5	7 %	...	...	5 — 5½	4⅞— 5⅛xd	...	...
40,008	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4½— 5	4½— 5	4⅝	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	101 —104	103 —106	...	...
155,500	West African Telegraph, 5 % Debs.	100	...	...	...	100 —103	100 —103	...	...
80,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— ⅜	⅛— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Brzn. Sub. Tel.	100	...	...	...	99 —102	97 —100	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	11½— 12½	11½— 12½	12⅛	11⅞
75,000£	Do do. 5 % Debs. 2nd series, 1906	100	...	...	...	101 —104	101 —104	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	97 —100	98 —101	...	...
38,321	West India and Panama Telegraph	10	8%	...	...	⅜— ⅝	⅜— ⅝	⅞	...
34,563	Do do do 6 % Cum. 1st Pref.	10	...	...	...	5½— 5⅝	5½— 5⅝	...	...
4,569	Do do do 6 % Cum. 2nd Pref.	10	...	...	...	3½— 4½	3½— 4½	...	.
80,000£	Do do do 5 % Debs., Nos. 1 to 1,800	100	...	...	...	101 —104	97 —100	...	...

ELECTRICITY SUPPLY COMPANIES.

100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	1	...	...	...	⅛— ⅜	⅛— ⅜	...	...
100,000	Do. 4½ % 1st Deb. Stock, Prov. Certs.	100	...	...	...	100 —104	100 —104	...	...
19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	8 %	9 — 9½	9 — 9½	...	...
20,000	Do. do. 7 % Cum. Pref.	5	...	...	..	9 — 9⅛	9 — 9⅛	...	...
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	9 — 10	9 — 10	9 7/16	9 5/16
50,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5½— 5⅝	5½— 5⅝	5⅝	...
250,000	Do. do. do. 4% Deb. Stock Red.	100	...	...	..	105 —107	105 —107	105⅛	.
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	5½%	4 %	5½— 5⅝	5½— 5⅝	5⅝	...
150,000£	Do. do. do. % Deb. Stock Red.	Stock	...	...	...	109 —112	109 —112	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579	10	4 %	0 %	5 %	8 — 9	8½ — 9½	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	11½— 12½	11½— 12½	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	121 —126	122 —127	125	124
200,000	Do. 4½ % 2nd Deb. Stock, Prov. Certs., all paid	100	...	...	...	103 —106	101 —104	103⅛	102
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	4 %	4 %	4 %	8 — 9	8 — 9	8⅜	8⅜
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11½— 12½	11½— 12½	...	..
400,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Red.	...	...	...	..	109 —112	108 —111	108⅜	..
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	7 %	7 %	6½— 6⅝	6 — 6¼xd	6 1/16	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	6 — 6½	6 — 6½	...	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock.	100	...	...	...	107 —110	105 —108 xd	..	...
21,009	Kensington and Knightsbridge Electric, Ord.	5	11%	12%	10%	10 — 11	10 — 11	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	1½— 1⅝	1½— 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	...	...	4 — 4½	4 — 4½	4⅛	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Red.	Stock	...	...	...	94 — 99	94 — 99	...	
98,769	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	6½%	16 — 17	16 — 17	16½	16¼
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	...	...	...	109 —113	109 —113	...	...
250,000£	Do. 3½ % Mort. Deb. Stock Red.	Stock	...	...	...	98 —101	98 —101	...	...
8,652	Notting Hill Electric Lighting	10	7 %	7 %	6 %	14 — 15	12½ — 14½	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14½— 15½	14½	...
20,000	Do. do. 7 % Pref., 20,001 to 40,000	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
150,000£	Do. do. 3½ % Deb. Stock Red.	100	...	...	...	97 —100	97 —100	100	99½
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	1½— 2½	1½— 2½	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2⅜— 3½	2½ — 3	...	...
109,518	Westminster Electric Supply, Ord.	5	13 %	10½ %	10½%	11 — 12	10½ 11½	11½	10⅝

* Subject to Founders Shares. ‡ Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. † Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‡ are for a year, consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotation July 9th.	Closing Quotation July 16th.	Business done week ended July 16th, 1902. Highest.	Lowest.
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	4½ — 5½	4 — 5	...	...
£600,000	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...		86 — 90	83 — 88	...	...
62,074	British Electric Traction	10	8 %	9 %	9 %	12 — 13	12 — 13	12⅝	12⅜
90,000	Do. do. 5 % Cum. Pref.	10	...	...	...	12 — 12½	12 — 12½	12⅝	12½
£600,060	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	124 —127	124 —127	126	124½
70,000	British Insulated Wire Ord.	5	20 %	15 %	10 %	7½ — 8½	7½ — 8½	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6 xd	...	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	8 %	...	13s. to 15s.	13s. to 15s.	...	...
50,000	¶ „ „ „ 6 % Cum. Pref.	£1	...	6 %	..	16/6 to 17/0	16/6 to 17/0	...	...
105,731	Brush Elecl. Engng., Ord., 1 to 105,731	2	5½ %	5 %	Nil	1½ — 1⅝	1½ — 1⅝	...	...
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	3 %	1⅞ — 2¼	1⅞ — 2¼	1⅞	...
£25,000	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	101 —104	101 —104	103⅝	...
£25,000	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	94 — 99	95 —100	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	20 %	16 — 17	15½ — 16½	...	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6	...	...
£20,000	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	109 —113	109 —113	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	4 %	106 —109	106 —109	107⅛	...
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	4 %	107 —110	107 —110	108	107½
440,100	Do. do. Def. do.	Stock	...	...	4 %	104 —107	103 —106	105	104⅝
855,000	City and South London Railway	Stock	1⅞ %	1½ %	2 %	74 — 76	73 — 75	73½	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	7½ %	8 %	...	3 — 3½	2⅞ — 3¼	3	...
£100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	101 —106	101 —106 %	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	2½ %	...	⅛ — ⅜	⅛ — ⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	2½ %	...	1½ — 2½	1½ — 2½	...	...
£44,023	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	76 — 81	76 — 81	...	...
£100,000	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	82 — 86	82 — 86	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1½ — 1⅝	1½ — 1⅝xd	...	...
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390... ...	2	...	...	...	2½ — 3	2½ — 3 xd	...	...
£82,500	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	99 —102	97 —100 xd	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	9⅝ — 10½	9⅝ —10½	10½	9¹⁵⁄₁₆
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	98 — 101	98 —101	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	20 %	16 — 17	16 — 17	...	...
35,000	Do. do. do. 4½ % Pref.	5	4½ %	4½ %	...	5½ — 6	5½ — 6	...	...
£50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	111 —115	111 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	...	...
£100,000	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100 —103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½ %	3½ %	1½ %	4¹⁵⁄₁₆ — 4¹⁵⁄₁₆	4¹⁵⁄₁₆ — 4¹⁵⁄₁₆	...	...
10,000	† Do. do. Pref., £10 paid	10	5	...	..	10½ — 11	10½ — 11	...	...
7,500	Parker (Thomas), Limited, Ord., Nos. 1 to 7,500	10	...	...	...	15½—16½	14½— 15½xd	...	...
	§Rosling & Fynn 6 % Cum. Pref.	£1	...	6 %	..	19/0 to 20/0	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	17½ %	20 %	36 — 38	35 — 38	37½	36½
£50,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	... %			101 —104	102 —105	104½	...
25,000	Telegraph Manufacturing, Ord. Nos. 1 to 25,000	5	12 %	12 %	...	9½ — 10½	9½ — 10½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½ — 6	5½ — 6	..	...
£40,000	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	93 — 96	92 — 95	92	...

* Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, $\frac{1}{16}$—$\frac{5}{16}$.
National Electric Free Wiring, —1.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14½—15.
Do. do. Pref. (£10 pd.), 10⅜—10⅝.

* From Birmingham Share List. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (February 6th, 1902).

MARKET QUOTATIONS, Wednesday, July 16th.

CHEMICALS, &c.	This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	22/-	22/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	42/-	42/-	..
a Ammonia, Muriate (crystal) .. per ton	£32 10	£32 10	..
a „ „ (dry) .. per ton	£30	£30	..
a Bleaching powder .. .. per ton	£7	£7	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£12	£12	..
a Benzole (90 %) .. .. .. per gal.	1/-	1/-	..
a „ (50/90%) .. .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£19	£19	..
a Lead, Nitrate .. .. .. per ton	£24	£24	..
a „ White Sugar .. .. .. per ton	£31	£31	..
a „ Peroxide .. .. .. per ton	£37 10	£37 10	..
a Methylated Spirit .. .. per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C). per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	9d.	9d.	..
a „ Caustic (76/80%) .. per ton	£24	£24	..
a „ Bisulphate .. .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	102/-	102/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£8 5	£8 5	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 76 %) .. per ton	£10 15	£10 15	..
a „ Crystals .. .. .. per ton	£3	£3	..
a Bichromate, casks .. per lb.	3½d.	3½d.	..

METALS, &c.			
b Aluminium Ingots, in ton lots per ton	£148	£148	..
b „ Wire, in ton lots per ton	£224	£224	..
b „ Sheet, in ton lots per ton	£191	£191	..
p Babbitt's metal ingots.. .. per ton	£40 to £140	£40 to £140	..
c Brass (rolled metal 9" to 12") basis per lb.	6¾d.	6¾d.	..
c Tube (brazed) .. .. per lb.	8¼d.	8¼d.	..
c „ „ (solid drawn) .. per lb.	7d.	7d.	..
c „ Wire, basis .. .. per lb.	7d.	7d.	..
c Copper Tubes (brazed) .. per lb.	8¾d.	8¾d.	..
c „ „ (solid drawn) .. per lb.	9d.	9d.	..
g Copper Bars (best selected) .. per ton	£69	£69	..

METALS, &c. (*continued.*)	This week.	Last week.	Inc. or Dec.
g Copper Sheet .. .. .. per ton	£69	£69	..
g „ Rod .. .. per ton	£69	£69	..
c „ (Electrolytic) Bars .. per ton	£63	£63	..
c „ „ Sheets .. per ton	£75	£75	..
c „ „ Rod .. .. per ton	£68	£68	..
c „ „ H.C. Wire per lb.	8d.	8d.	..
f Ebonite Rod .. .. .. per lb.	3/-	3/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
a German Silver Wire .. .. per lb.	1/5	1/5	..
h Gutta-percha fine .. .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. .. per lb.	2/11 to 2/11½	2/11½ to 3/0½	dec.
f Iron, Charcoal Sheets .. .. per ton	£18	£18	..
f „ Pig (Cleveland warrants) .. per ton	50/3	50/11½	8½d. dec.
f „ Forgings, according to size per ton	From £11	From £11	..
f „ Scrap, heavy .. .. .. per ton	47/6 to 50/-	47/6 to 50/-	..
f „ Wire, galvanised No. 8 .. per ton	£9 15	£9 15	..
g Lead, English Ingot .. .. per ton	£11 10 to £11 12 6	£11 10 to £11 12 6	..
g „ „ Sheet .. .. per ton	£13	£13	..
m Manganin Wire No. 32 .. .. per lb.	8/-	8/-	..
g Mercury .. .. per bot.	£8 15	£8 15	..
d Mica (in original cases), small .. per lb.	3d. to 9d.	3d. to 9d.	..
d „ „ „ medium per lb.	1/6 to 2/9	1/6 to 2/9	..
d „ „ „ large .. per lb.	3/6 to 7/8	3/6 to 7/8	..
p Phosphor Bronze, plain castings per lb.	11½d. to 1/2	11½d. to 1/3	..
p „ rolled bars & rods per lb.	1/- to 1/8	1/- to 1/8	..
p „ „ strip & sheet per lb.	From 1/2	From 1/3	..
c Platinum .. .. .. per oz.	£4 1	£4 1	..
p Silicium Bronze Wire .. .. per lb.	9d. to 1/-	9d. to 1/-	..
f Steel, Magnet, acc'd'ng to desc'p'n per ton	From £15	to £40	..
f „ „ in bars	£58	£58	..
g Tin, block .. .. per ton	£127 to £128	£126 to £127	£1 inc.
g „ foil .. .. per lb.	1 6	1/6	..
a „ wire, Nos. 1 to 16 .. .. per lb.	1 6	1/6	..
p White Anti-friction Metals —			
"White Ant" brand .. .. per ton	£36 to £69	£35 to £65	..
f Yarns, 2/16s Grey Cotton, on sp'le per lb.	7d.	7d.	..
f „ 6 lea. Flax .. .. .. per lb.	5¾d.	5¾d.	..
f „ 3 ply 16 lbs. Russian .. per lb.	4¹⁵⁄₁₆d.	5¹⁵⁄₁₆d.	..
f „ 10 lbs. Russian, single .. per lb.	4¼d.	4¼d.	..
f „ 180 lbs. Jute rove .. .. per ton	£11 10	£11 10	..
h Zinc, Sh's. (Vieille Montagne brd.) per ton	£23	£23	..

Quotations supplied by { a Messrs. G. Boor & Co. / b The British Aluminium Co., Ltd. / c Messrs. Thos. Bolton & Sons. / d Messrs. F. Wiggins & Sons. / e Messrs. Frederick Smith & Co. }

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works / g Messrs. James & Shakespeare. [Co., Ltd. / h Messrs. Edward Till & Co. / i Messrs Bolling & Lowe. / Messrs Walter H. Hindley & Co. }

Quotations supplied by { k Messrs. Morris Ashby, Limited. / m Messrs. W. T. Glover & Co., Ltd. / n Messrs. P. Ormiston & Sons. / o Messrs. Johnson, Matthey & Co., Ltd. / p The Phosphor Bronze Company, Ltd. }

THE MUNICIPAL ELECTRICAL ASSOCIATION—1902 CONVENTION.

The papers read at this Convention recently were indicative of the fact that the problems presented to the supply engineer are likely in the future to be included in either of two main groups. The immediate problem for solution is that dealing with cases in which the generating station is situated in the centre of a district which makes considerable demands upon it, but which must in the course of development extend its area to take in outlying districts. The more remote problem, already present with us in the metropolis however, is presented by cases in which the original generating station has become so large that further extension is impossible, and new works have to be built outside the area of distribution, where land is comparatively cheap, and there is plenty of room for future extensions.

The first paper read at the Convention, on "Double-current Generators and their Application," by Mr. Ruthven Murray, had reference to the first of these problems. It dealt with cases in which there was a considerable demand for current in the vicinity of the generating station, which could be supplied at 500 volts pressure, but in which the area of supply was so extensive as to necessitate transmission at a much higher pressure to reach the outlying districts. As solving the problem presented in such cases, Mr. Murray proposed the adoption of double-current generators, which, as is well known, are continuous current machines with the armature winding tapped at several points and connections made therefrom to slip rings, whereby two-phase or three-phase alternating currents can, simultaneously with the continuous current, be taken from the armature. These low pressure alternating currents are transformed to high pressure, and the electric energy is in this form transmitted to the outlying districts in the supply area. This proposal is not by any means new, indeed, such suggestions were made quite 10 years ago, and it certainly is a somewhat remarkable circumstance that though double-current generators have been in existence for all these years and their properties have been very well known, they have been adopted to no appreciable extent either on the Continent, which is their birthplace, or in this country, which is within easy reach of it.

From this it would appear that there is no real advantage in employing such generators; on the other hand, direct coupled sets in which there is at one end of the engine a dynamo and at the other end an alternator are quite common. The double-current generator is bad from the continuous current point of view, because the frequency is too high; it has too many poles, and in consequence a multitude of brushes to look after; from the alternating current point of view it is bad, because the output coefficient is low, and transformers are required to obtain the high pressure for distant transmission, to say nothing of the switch gear appertaining thereto. The machine, as the President put it, is merely a rotary converter, steam driven, and, needless to say, no designer in his senses would take a rotary converter as indicating the lines on which either a continuous-current generator or an alternator should be made. However this may be, the electrical world will look forward with interest to the results of Mr. Murray's own venture with the double-current generator at Willesden.

As regards the regulation of such machines, it was pointed out by the author that the pressure ratio of continuous to alternating current was unalterable, and that it was accordingly most convenient to regulate for the home circuits, that is, for the continuous currents, the pressure of the alternating current serving the distant circuits being regulated by a booster. The boosting may be done in three different ways. The first way is by means of a multiple contact switch on the primary or secondary side to alter the pressure ratio of the step-up transformers. The second plan is to have separate induction boosters by which the pressure on the secondary can be regulated due to varying the number of induced lines of force threading the coils. The third method is to pass the current to be boosted through coils on a stationary armature, inside which rotates a field magnet system, which can be mounted on the same shaft as the double-current generator, the boosting being done by varying the current exciting the field. Comparing these three, multiple contact switches are liable to give trouble, unless they have a great number of steps; for regulating the pressure in three phases they are consequently cumbersome, and though, when properly constructed with double contact bars and choking coil they have been very successful for pressures up to 1,000 or 2,000 volts, they are always open to the fundamental objection that their action depends upon the efficiency of a series of contacts interposed in the main circuit. The induction booster is better, because there are no such contacts. This appliance is, in reality, a transformer, in which the disposition of the secondary winding relatively to the primary can be varied, so as to bring the former more or less under the inductive influence of the latter, and thus raise or lower the pressure. The variation is done mechanically, and there need be no sliding contact in either primary or secondary circuits. Generally this booster takes the form of a cylindrical laminated core wound with coils to form the primary, inside which is placed an iron laminated drum pierced with holes round the periphery, in which are wound the secondary coils. Through the latter passes the current to be boosted, the pressure being raised according to the angular position of the drum. The writer has only come across single-phase boosters of this kind, not three-phase, and as regards the latter, it would appear that, if we are to have an apparatus consisting of a fixed part and a movable part, we might as well let the latter rotate, and thus adopt for boosting the third plan, which consists of employing a small alternator. On an extension of the generator shaft a magnet wheel is fixed, and surrounding this is a stationary armature wound for the three-phase currents to be boosted. The current from the alternating side of the double-current armature may be passed through the booster armature at low pressure, in which case the booster winding would be bars, or at high pressure after being stepped-up, in which case the winding would be coils. This booster would cost less than the induction booster previously referred to, and as the regulation is effected by varying the excitation of its field magnet, the manipulation could all be done at the switchboard. Altogether, it has advantages which deserve full consideration, though there always remains the final question, whether, taking into account the cost of step-up transformers, boosters, and extra switchgear, the double-current generator is worth having. What is wanted is simplicity, and every extra appliance required for the working of any particular system introduces a fresh element of risk.

All the foregoing remarks apply to generating, but when with the high-pressure currents the outlying districts are reached, some of us are likely again to fall foul of Mr. Murray's schemes. In the discussion which followed the reading of the paper, Mr. Wordingham made the astounding observation that continuous current was the only current worth distributing, and full of this idea, Mr. Murray coolly proposes in the outlying districts to convert all the three-phase currents into continuous. With the many examples of successful polyphase distribution before him, it would, in the opinion of the writer, puzzle any engineer to find sufficient justification at the present date for such a proceeding. If a bad start is made with a frequency of 25, matters must, of course, be set right by conversion. But why make a bad start? Anyhow, the only argument put forward by Mr. Murray in support of his views appeared to be exceedingly weak. "Our consumers," said he in his reply, "want continuous current, and that we must give them," to which observation the obvious rejoinder is that the customer does not care a single jot what kind of current he gets, provided it is suitable for his purposes and cheap enough.

The next paper read at the Convention was on "High-Tension Continuous-Current Systems," by Mr. Barnard, of Hull, and here again the problem of serving outlying districts was attacked, though in a different way. Mr. Barnard has been using at Hull continuous-current generators working at a pressure of 2,250 volts, and has obtained considerable success with them. That there is no difficulty in

construction offered by the high pressure *per se* has long been known; indeed, machines giving this pressure and with commutators such as are now employed, were made 12 years ago. The fact remains, however, that the so-called "Oxford system" is not persistent, and that better systems have arisen, while it is not too much to say that all the cost comparisons made in Mr. Barnard's paper between this system and others are vitiated by the assumption that it is necessary before distribution to convert into continuous current. Once admit the advantages of three-phase distribution, which will have to be admitted sooner or later, and all systems other than those embracing polyphase alternators and stationary transformers go by the board. Only for supply to tramway or light railway systems for which, as at present devised, continuous current is necessary, is any conversion to continuous current needed.

It is not to be implied that in particular cases the high-pressure continuous current may not afford a successful method of reaching consumers out of the 440-volt range. Mr. Barnard has been particularly successful, and his proposals have at least the merit of consistency in that, generating a continuous current, a continuous current it remains till it reaches the consumer. But the cost of continuous-current transformers as compared with the cost of stationary transformers has to be considered. The risk which running machinery, however first-class, always imposes on the system, as compared with the risk added by stationary appliances, has to be taken into account. The extra attendance required by the continuous-current transformer system must not be overlooked. And, taking all these things into account, it is evident that the results, successful though they be, are secured only at a much greater initial expenditure and running cost in one case than in the other. The retort may be made that one system gives all the advantages of storage while the other does not, and this, so far as it goes, is a fair argument; it does not, however, go very far, for it has often been shown that in proportion as the station increases in size the battery plays a less and less important part in its economics, while it may be added that just in proportion as the day load is increased does its utility diminish; in other words, as, by a process of natural development, the load curve is straightened out, the use of the battery for this straightening disappears.

Mr. Faraday Proctor's "Notes *re* Earthing" were extremely interesting. Briefly, he advised the use of an uninsulated return for two-wire distributing systems, and an uninsulated neutral for three-wire systems. There seems to be no real objection to the principle of earthing installations in this manner, provided it can be done in such a way as to satisfy all the conditions which should be observed.

The neutral conductor of a 400 to 500-volt three-wire system always has to be earthed for the sake of safety, but it is earthed at one point only, and the reason why it is elsewhere insulated throughout, is that the difference of potential between different points in the system would, in the case of an uninsulated conductor, give rise to stray currents bringing in their train all the evils of electrolysis. In the mere fact of earthing one point, the principle of earthing is admitted; the question is, how far is it wise to go in this direction?

At the present time it is usual to earth the neutral conductor of a three-wire system at the generating station. This means that the feeders are earthed, and there may well be at full load between the generating station end and the distributing end of the neutral, a difference of potential considerably greater than is permissible under Board of Trade tramway regulations. From a careful perusal of his paper, however, it would appear that Mr. Proctor does not contemplate the earthing of the feeders throughout; what he insists upon is the efficient and complete earthing of one side of the distributive system, and the feeders would accordingly be earthed, not at the generating end, but at their far end where they join the distributors.

Mr. Proctor proposes that the uninsulated conductor should be equipped with a number of good earth plates in order to ensure efficiency in the earth connection, this being, of course, the crux of the whole matter. That there is nothing gained by a multiplicity of earth plates, provided the distributive system is continuous, will, however, be obvious, since all that is wanted is one thoroughly good and reliable earth connection on the distributive system. If the difference of potential between any two points on the uninsulated conductor is too great, it shows that the conductivity is too low and more copper must be put in, for the total conductivity is not likely to be increased to an appreciable extent by earth plates. The latter may, indeed, prove an evil, since, if there were any difference of potential between various points of the uninsulated conductor, they would by making efficient earth at these points encourage the flow of stray currents. If, on the other hand, the difference of potential is within the permissible limits, the introduction of earth plates is not likely to improve matters. Everything considered, there is no reason why the uninsulated neutral on a three-wire system should not have a trial in this country at an early day. Already on the Continent it is in use, and has proved satisfactory; as regards two-wire systems, however, the writer has doubts as to whether, on the whole, the plan of leaving one side uninsulated has any advantages to offer over the present practice. That the indiscriminate use of uninsulated returns on the consumers' premises cannot be allowed, whether one of the distributors is uninsulated or not, is obvious. This is a matter which must be decided in each individual case by the station engineer, as it is quite possible that the drop of pressure on a long uninsulated service wire might put two points to earth between which there is a considerable difference of potential, the usual results and trouble following. Again, warehouses and buildings with plenty of iron in their construction have to be considered in a different light from buildings without iron, and in each case the engineer would have to give the matter very careful consideration in order to arrive at a sound judgment.

In the paper read by Mr. John F. C. Snell, of Sunderland, entitled "The Relative Advantages of Two and Three-wire Distribution," it was suggested that the advantages possessed by the simpler two-wire system had, perhaps, been lost sight of in the almost universal adoption of the three-wire system. It will be readily conceded by every fair-minded engineer that the sole advantage of the three-wire system lies in the fact that by its use the same results can be obtained with a much less expenditure on mains than is possible with the two-wire system. The advantage brings in its train some disadvantages, such as the use of balancers, the difficulty sometimes of balancing the sides of the system, the less simple switchboard arrangements, and the less simple system of mains. These disadvantages are not serious, but they would be enough to turn the scale in favour of the two-wire system were it not for the great saving in the cost of mains which the three-wire system can show. It is merely a question of £ s. d., and it is quite conceivable that under some circumstances it might pay to start with two wires rather than with three, though such cases might be rare. Mr. Snell only admits an increase in the cost of mains for the two-wire system of 8 per cent., but this certainly does not measure the amount accurately. He begins his paper by stating that the three-wire system saves 40 per cent. in copper over the two-wire, but, as was shown by Mr. Murray in the discussion, the saving is 68 per cent. when full advantage of the system is taken. Mr. Snell admitted that it might be so theoretically, but in practice it was as he stated, and he had worked out the cost comparison given in his paper on the basis of the same current density for both two and three-wire. One is inclined to ask why he should do anything of the sort? Granted that it would not be possible, in the case of three-wire, to work at double the current density throughout—which, to take the full advantage of the system, ought to be done—it is generally possible to work at a much higher density than for the two-wire, because the pressure drop in long feeders necessitates for the two-wire a very much greater section than would be required if only the density limit were considered. On short feeders, perhaps, the current density could not, with three-wire, be much increased, but on long feeders it is quite different, whence the conclusion which was to be expected, that the greater the extent of the area served, the greater the advantage of the three-wire system over the two-wire. Obviously Mr. Snell errs in assessing the gain in the former system at so low a figure, and while the reduction of copper weight may not be so great as 68 per cent., in all fairness it should cer-

tainly be taken at a much higher figure than 40. In the examples worked out in the paper the author goes from bad to worse, as he only allows 5 per cent. to be saved, and naturally, as was pointed out by more than one speaker, these erroneous assumptions vitiate all his conclusions.

W. B. E.

EARTHING PROBLEMS.*

It is a really delightful little piece of satire with which Mr. Proctor commences his paper on "Earthing." It is always he who makes a special study of any subject who must confess his ignorance, in the presence of those casual observers who "settled the question years ago." *Everybody knows* that a fuse should on no account be placed in an earthed conductor; more particularly if that conductor be connected with the earthed neutral of a three-wire system.

Those others who have, like Mr. Proctor, given some thought to the matter, know how erroneous is this prevailing idea. For convenience, Mr. Proctor has divided the subject into sections, and the first question he asks is, "Should a switch, or fuse, be placed in a conductor which is uninsulated throughout its length in connection with a two-wire installation?" By *uninsulated* he means *not intentionally* insulated. The answer is "No." Such a case is, however, a very unusual one. A single-wired ship installation, or an installation in an iron building, in which one insulated conductor is run in a metal pipe, or sheath, forming the return, the pipe being in intimate contact with the building throughout, is the nearest approach to such a condition. Obviously, neither switch nor fuse in the "earthed" conductor would be of the slightest use, as there is everywhere a duplicate route through the hull, or "earth."

Generally speaking, however, the condition is an impossible one, and the metal sheath makes "earth" here and there only. Take the case of a cotton mill or factory installation, wired on an earthed concentric system. For the greater part of their length the branches are attached to wood beams, and so, practically insulated from earth. A break in the outer, either by means of a switch or fuse placed at the earthed end of the branch, would not interrupt the circuit; the current would be merely diverted to the nearest earth, possibly overheating the outer at the latter point. This example may suffice to support the contention that it is useless and dangerous to use fuses or switches in an earthed conductor under these or similar conditions.

The second case considered is one in which the distributing system is earthed at one place only, say, near the generating station. In this case Mr. Proctor would not permit the use of an uninsulated conductor or any earth on a consumer's installation, and suggests that fuses be used both on the supply side and on the lamp side of the conductor. Unless this be done, the existence of an earth fault in the consumer's premises on the earthed conductor "would shunt not only the return current of the particular installation on which the fault exists, but of all other installations on the same distributing system." It is not clear from the language employed, whether we are to assume that both branches are insulated, or one pole is earthed on all the neighbouring installations, or not. If not, then why should the return current be diverted from such installations to the fault? It would also appear from the paper that Mr. Proctor would be satisfied with a main fuse on the supply side of the installation and on one pole of the branch. He would then depend, for protection, on the blowing of the *supply* fuse, in the event of a portion of the return current from other installations being shunted to the fault. But this would not protect the faulty branch against current from other portions of its own installation. The safer method is to fuse both poles of the branches. A few simple diagrams would have made the argument much easier to follow.

In the diagram fig. 1, let A and B represent the supply mains, B being earthed near the generating station at E. Let D B + and D B − be the two panels of a distributing board, feeding five 5-

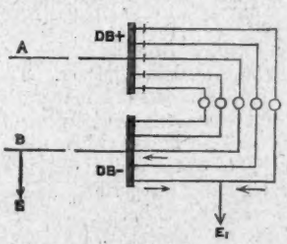


FIG. 1.

ampere circuits. No. 1 circuit "earths" at E_1. The positive fuse does not "blow;" there is no reason why it should. If, however, there are no fuses on the earthed negative side, part of the 20 amperes from the remaining four circuits will pass down the negative side of the branch from D B − to E_1, and quite possibly burn it out, or set fire to the premises. Fuses in the negative pole would prevent this, and would also protect the branch from outside current, even in the absence of a supply fuse. The fuses on the "earthed" side should be larger than those on the live side, as, whilst the blowing of one of the latter makes its conductor dead, the blowing of the former puts out the lights, and still maintains the conductor alive. Instead of 5-ampere lighting circuits, the above might be individual motor circuits. In this case the risk is more serious. A conductor may easily "earth" in a cast-iron switch box, when, unless fused on the "earthed" side, the return current from the other motors, which might be of considerably larger powers, would flow, in part, down the faulty branch. The same conditions hold good for an installation connected to one side of a three-wire system with earthed neutral.

In discussing installations connected to a three-wire system, that is, where three wires are brought into a consumer's premises, the author of the paper makes himself quite clear, and we are in entire agreement with him. Each side must be treated as a separate two-wire installation and both poles fused. There is, however, less risk in this case than in a plain two-wire system of distribution, as only the unbalanced current would tend to pass down the fault. On no account should a fuse be placed in the supply side of the neutral conductor, whether earthed or not, and in any case it should be assumed that the neutral is, or may become, earthed. Here again we are happy to be in entire agreement with the author.

There is, however, an alternative and safer method of dealing with the matter from the consumers' point of view; and that is to earth the distributing bar of the main distribution board on the pole connected to the earthed main. When this is done, there is no tendency for any current to flow past the bar to a fault on any of

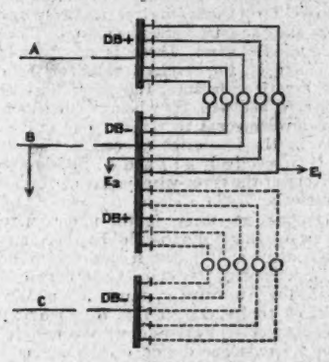


FIG. 2.

the branches. Nor is there the same risk of leakage current from the branch on which the fault exists, as the resistance of the conductor between the fault and the distributing bus bar must of necessity be very small as compared with the resistance of the fault.

The diagram, fig. 2, shows the suggested arrangement, the full lines representing a two-wire installation, and the dotted lines (in addition) a three-wire installation. Whilst this solves the difficulty so far as the consumer is concerned, it adds to that of the supply authority whose main is only earthed at the station. The solution (for them) is to earth the main throughout. We would go further than Mr. Proctor, who suggests a sufficient number of good earth plates, and advise one continuous earth plate—that is to say, a bare copper conductor of ample section. This might be either a plate laid alongside the insulated conductor or a copper sheath over the conductor. This would be as flexible as either steel or lead, and would be easily jointed. Only by some such system will the earthing problem be solved, and "unmuzzled currents" be prevented from "frolicking about," and "eating up the pipes of other undertakers," or setting fire to the premises of a consumer on some other system, even though the consumer's switches are "off."

F. B.

* "Notes *re* Earthing." Paper by Mr. H. Faraday Proctor, read July 4th, 1902.

TWO *v.* THREE-WIRE DISTRIBUTION.*

The three-wire system, which, with the enunciation of the theory of dynamo construction, forms the crowning triumph of the fertile brain of the late Dr. John Hopkinson, is doomed to sink into oblivion. Like other little systems, it has had its day; it has served its end, and must, therefore, cease to be. Such are the conclusions which force themselves upon us, if we grant that Mr. Snell's deductions are the result of sound reasoning based upon true premises.

We are, however, not prepared, without further argument, to grant either the one or the other; but, on the contrary, the more we study Mr. Snell's paper, the more are we persuaded that his views are based upon a misconception as to the relative values of copper in the two systems, and to an unfortunate experience with the cable systems under his control; an experience which might have occurred with any other system of distribution under similar conditions. The impeachment which Mr. Snell seriously and deliberately brings against the three-wire system is classified under eight sections, which may be summarised thus:—

1. Difficulty of balancing consumers.

* "The Relative Advantages of Two and Three-wire Distribution." Paper read by Mr. J. F. C. Snell, July 4th, 1902.

2. The larger section, in practice, of the middle wire, above the theoretical section.
3. Switchboard complications.
4. Less reliability of supply as compared with the two-wire system.
5. The burning out of consumers' lamps due to short-circuits between the middle and an outer conductor.
6. The effects of permanent stress, electrolysis, and osmosis on the negative cable due to earthing the middle wire.
7. Electrolytic action on pipes, &c., due to leakage.
8. Difficulty in localising and rectifying faults on the middle wire, without interference with supply.

Beyond the mere schedule, very little is said about many of these alleged disadvantages, the paper resolving itself into an attempt to prove that the cost of the two-wire system of distribution is only 8 per cent. more than the cost of the three-wire system. And how is this attempted? By comparing two 0·2 sq. in. conductors, with two of 0·1 sq. in., and one 0·06 sq. in., that is to say, the relative weights of copper in the two cases would be in the proportion of 4 to 2·6—a saving of about 40 per cent. in favour of the three-wire.

As was pointed out by Mr. Ruthven Murray and others in the discussion, this is not stating the case fairly. Assuming the same percentage drop in voltage in the two cases, the sizes for the three-wire system would be only half the values given in the paper, making the ratio 4 to 1·3, which means a saving of about 68 per cent. in favour of the three-wire system.

But Mr. Snell will have none of it. He says that in practice the values are greater than the theoretical values, and 40 per cent. is correct. Why should this be so?

Surely Ohm's law is as applicable to the three-wire as to the two-wire systems, and, this being so, the two outers must be exactly one-quarter the section of the conductors in a two-wire system for the same energy loss and the same percentage drop. The only doubtful quantity is the middle wire. There is no theoretical value for this. It depends upon the assumed value of the out-of-balance current. With a perfect balance, the theoretical section of the middle wire is zero, and with the whole of one side off, the section need only have a value equal to that of one of the outers. The relative values in the two cases as compared with a two-wire system would be respectively 4 : 1 and 4 : 1·5, showing an economy in copper in favour of the three-wire system of 75 per cent. and 62·5 per cent. respectively.

In the first case (*i.e.*, no current in the middle wire) the percentage voltage loss on the system would be the same as that in the two-wire distribution; and, in the second case (the whole system unbalanced) the percentage loss on *one* side of the system only is double that in the two-wire system. A suitably-proportioned balancer would, of course, correct this to some extent, but it is clear that when any current passes down the middle wire, the percentage loss on the unbalanced side of the system is greater than in the two-wire if the relative sections of the conductors are as 4 : 1.

This is, no doubt, what Mr. Snell had in mind in saying that the practical values exceed the theoretical. The question resolves itself then into one of "balance," and the consensus of opinion among the three-wire men who took part in the discussion, was that there is no difficulty in obtaining this, and, instead of the difficulties increasing as the lamp density rises, the opposite is the case.

We are not in a position to check the figures given by Mr. Snell, but it strikes us as somewhat disproportionate that with 40 per cent. difference in the value of the copper, the difference in the cost of distributors is only 8 per cent., viz., £78 as against £72. The value of the copper in the two cases is about £17 and £11·7, the balance £60 to £61 being accounted for by insulation and laying. Possibly these are actual quotations from cable makers. As to the feeders on the three-wire system, we are not told if these consist of three wires or two, with a balancer at the distant end, but we assume that the most favourable conditions have been taken.

We were somewhat surprised to hear not only Mr. Snell, but other speakers, refer to the current density in cables as a factor in determining the size. We thought it was only insurance companies who spoke this language. For instance, Mr. Snell justified his figures for the three-wire distributor on the ground that, had he taken the correct values—viz., half what he gives in his paper—the current density in the middle wire would have been 1,200 amperes per sq. in.; and Mr. Ruthven Murray was not surprised that the variation of pressure on the Sunderland system was small if some of the feeders carried currents at only about 200 amperes per sq. in. density. We fail to see any connection. A 30-ampere cable would not rise in temperature appreciably when working at a density of 1,200 amperes per sq. in.; and, on the other hand, there might be a considerable pressure variation in a feeder working at 200 amperes per sq. in. if long enough.

Such language is unscientific. Mr. Snell's principal complaints against the three-wire system are really difficulty in balancing, and electrolytic and osmosis troubles. If the cables are properly laid, the latter are insignificant. When responsible manufacturers will guarantee their cables, if properly laid, for 20 years, and undertake to maintain them for 2 per cent. per annum, it is clearly neither the cable nor the system that is at fault.

Nor is the author quite consistent, for towards the end of the paper, notwithstanding the array of figures he brings forward to prove the false economy of the three-wire system, notwithstanding the balancing difficulty, the complication, the unreliability, the burning out of consumers' lamps, the destruction of water and gas pipes, and the difficulty of localising faults; in spite of all these disadvantages, he says "were it not for the infallible troubles which must result from the physical effect of negative leak, he would be among the first to recommend a system, which so obviously involves less outlay and less loss in distribution." He believes, however, that in years to come his opinion will be justified, and that the simple two-wire system will be found to be a safer investment than the more fashionable three-wire.

We can admire a man who has sufficient courage and faith in his own convictions to read a paper before a Scientific Association on such a revolutionary subject, and the best we can wish him is that he may live to see the day in which his opinions are accepted.

F. B.

THE INTERNATIONAL TRAMWAYS UNION CONGRESS, 1902.

(*Continued from page* 85.)

The Congress at their meeting on Thursday, July 3rd, restricted their attention to two papers, but the thoroughness with which they were discussed may be gauged by the fact of the sitting lasting five hours, and had it not been that the hall was then wanted for the meeting of the Incorporated Municipal Electrical Association, it might have been still further prolonged.

During the early part of the sitting the chair was occupied by Mr. John Young, the manager of the Glasgow tramway system. In his remarks, Mr. Young mentioned that he thoroughly appreciated the unexpected honour done him. He had another meeting to attend later in the morning, but in common with every other tramway manager, he welcomed the Congress to London, and trusted the meetings would prove helpful to all. He had the pleasure of attending the last Congress at Paris in 1900, and he had derived great help from a perusal of the papers then read. He was glad that we had now an opportunity of reciprocating the many acts of courtesy we had received from our Continental friends, and he again wished the Union every success.

The first paper was read by M. Poetz, the chief engineer of the Hamburg Tramways Company, on "Brakes." The paper was mainly an analysis of replies received from a number of tramway companies, members of the Union, to whom a list of questions had been sent. It, therefore, dealt exclusively with Continental practice, and it should be considered in conjunction with the paper on the same subject read by Mr. C. J. Spencer the following day before the Association of Municipal Tramway Managers. The writer stated that replies had been received from 20 companies, but that in many cases the information was of such a general character that it was difficult to base any definite conclusions upon it. All the companies employ electric traction in whole, or in part, and all have the ordinary hand brake, the electric cars in addition having some class of electrical brake either of the emergency or counter-current type, or the electro-rheostatic design.

Eight of the companies find that the hand brake is sufficient for ordinary working; three others use it as their standard on certain routes, in all cases an electric brake being held in reserve for use in emergencies. On the remaining lines some form of electric or pneumatic brake was used in ordinary working, in conjunction with the standard hand brakes.

Dealing with compressed air brakes, the "Standard" type is used in Berlin, Liège, Leipsic, Munich and Nuremberg, either on all or some of the cars; the Westinghouse brake is employed on all lines in Brussels having steep grades, and the Carpenter brake is used at Hanover. The practice with regard to brakes on trailer cars differs to practically the same extent. Many companies rely entirely upon hand brakes, but where compressed air brakes are in use, the same principle is usually applied to the trailer cars. The paper next deals with the regulations regarding brakes drawn up by the authorities in different cities. It appears that while it is the rule to ask for efficient brakes, the companies are usually free to adopt whatever system they like, subject to the approval of the authority.

Then follow the views of five tramway companies who use the hand brake, the general opinion being that it is suitable for lines with few gradients; it is simple and sure in action, completely under the control of the driver, but the working expenses due to wear and tear are heavy.

Seven companies express their opinions on the need of both electric and hand brakes. While admitting the efficiency and rapid action of the electric brake, it is stated

that the effects of its constant use on the motors are detrimental, especially in the direction of heating the armature windings. Other seven companies give their experience with compressed air brakes. These are certainly satisfactory and effective, but their cost is high, the space taken up is important, and the working expenses are, in some cases, considerable. Several companies complain of their tendency to freeze in very cold weather, thus disabling the car at possible busy seasons. A number of companies have special systems for training their drivers in the proper use of the brakes at their disposal, and this plan has, in many cases in the United States, been found to be very effective in reducing working expenses.

The writer then specifies what, in his opinion, are the requirements a good brake should fulfil, and goes on to examine how far the usual types in use comply with them. The constant use of the hand brake tires the driver, and thus introduces a possible element of danger, and in times of snow it may become blocked and of little use; otherwise for light cars used on fairly level roads with moderate speeds it is effective and cheap.

Electric brakes are prompt in action, and require little expenditure of power on the part of the driver, but there is a tendency for the wheels to skid if they are too suddenly applied. The experience of the Hamburg Company is that their use does not entail any great increase in the cost of motor repairs and maintenance.

Some particulars are then given as to American tests made with various types of brakes, the different makers being classed in order of merit. The general conclusion is that as regards certainty of action and general efficiency there is little to choose between the compressed air and electro-magnetic brakes, but that further information is necessary to enable any very definite conclusions to be drawn on the matter.

The writer supplemented his paper by the following figures relating to some recent tests of cars:—When running a certain type of car at a speed of 14 kilometres an hour, the Helios electro-magnetic brake brought the car to a standstill in 15·5 metres. With four other types of brakes the distance was 9 metres. When running at a speed of 20 kilometres an hour the Helios brake stopped the car in a distance of 21 metres, the Siemens & Halske electric brake in 13 metres, the Schuckert electro-magnetic brake in 15 metres, the "Standard" air brake in 16 metres, and the "Carpenter" air brake in 16·7 metres.

At 25 kilometres an hour the results were:—Helios brake 27·2 metres, Siemens & Halske 17·8 metres, Schuckert 24·5 metres, "Standard" air brake 23·6 metres, and "Carpenter" 24·2 metres. Finally, at 32 kilometres an hour, the figures were:—Helios brake 43·4 metres, Siemens and Halske 27·2 metres, Schuckert 43 metres, "Standard" 38·8 metres, and Carpenter 35·8 metres.

M. Thonet, of Paris, practically agreed with the conclusions arrived at by the writer of the paper. The results at Marseilles proved that the first cost of the air brake if applied to a motor car and trailer was more than three times that of the electric, being 2,000 francs for the air, as against 600 for the electric. He had conducted a series of trials with one of the latest types of air brakes, an electric brake of a type made by the General Electric Company of America, and also an improved type of electric brake manufactured by the French Thomson-Houston Company. Tested at a speed of 20 kilometres per hour, the distances in which the car could be brought to rest were:—

For one car	... ...	14	metres	with air brake.
"	... ...	12·5	"	" American electric brake.
"	... ...	11·6	"	" French " "
For one car and one trailer		18·1	"	" air brake.
" "		15·6	"	" American electric brake.
" "		11·7	"	" French " "
For 1 car and 2 trailers		20·7	"	" air brake.
" "		19·4	"	" American electric brake.
" "		14·7	"	" French " "

He mentioned these to show that in the types of electric brakes at present in use there was a possibility of considerable improvement, and he thought that in the future the electric brake would prove itself superior to the air brake.

Herr Koehler, the managing director of the Berlin Tramways Company, was decidedly of opinion that the air brake was superior to the electric brake. His company were discarding the electro-magnetic brake in favour of the air brake, on account of its greater security and reliability. He looked upon this feature as most important, and he found, too, that it was an advantage for the driver always to be able to tell that his brake was ready for use by simply looking at a gauge. He had found the electric brake necessitated a considerable expense for cleaning, while its action was not so smooth and regular as with the air brake. Further, he could not accept the statement that the electric brake only caused an increase of 5° C. in the temperature of the motor. He could not agree with the figures as to relative cost given by the writer of the paper; he had found that for a car alone the figures were—electric 625 marks, air 1,000 marks, and for a trailer car, electric 425 marks, air 200 marks, making the relative costs for one car and one trailer, electric 1,050 marks, air 1,200 marks. He found that the relative cost of repairs over a given period was—electric 170 marks, air 127 marks. On these grounds, he himself preferred the air brake, but he thought, with the author, that more information on the subject was needed before the Congress came to any decision on the matter. He suggested that further inquiries be made, and the subject brought forward again at the next Congress.

In reply to Herr Koehler, M. Poetz stated that the electric brake in use in Berlin was a comparatively old design, and that during the past few years considerable improvements had been made. The form they had in use at Hamburg was, in several respects, superior to the brake tried at Berlin, which was more expensive as to cost and maintenance. This accounted for the difference in their relative costs.

M. Peiser pointed out how important it was to be able to stop the car completely and quickly in case of accident to the overhead conductor. He also would like to know whether any figures were available as to the actual power used in bringing a car to rest. Could any information be given as to the points of difference in the Hamburg and Berlin electric brakes?

M. d'Hoop emphasised the need which existed for a brake which should act with certainty in the event of a trailer car becoming disconnected from the motor car while ascending an incline.

M. Poetz admitted that neither the electric brake, as used at Hamburg, nor the air brake would satisfy this condition. It was, however, so remote a contingency that he attached little importance to it.

Herr von Lieber, speaking as the representative of the Austrian Government, stated that in Vienna a number of different types of brakes, both electric and pneumatic, including the form used in Berlin, had been tried. His experience differed from that of Herr Koehler, and he considered the electric brake superior to the air brake. The form of electric brake finally adopted in Vienna differed from that discarded at Berlin.

It was finally decided to further discuss the question at the next Congress.

(To be continued.)

E.E.R.E.(V.) AT PORTSMOUTH.

(By ONE OF THEM.)

A detachment of about 70 men of the Electrical Engineers (Vols.) has just undergone the annual training at Fort Blockhouse, Gosport, near Portsmouth, with Major Erskine in command. The recruits who went down on July 3rd were joined by the efficients on the 5th, the former being quartered in the fort and the latter under canvas.

Saturday and Sunday were passed quietly, no work being done on either day. The company attended Divine worship at Haslar Church on Sunday morning. On Monday morning the real work commenced, the detachment being divided up into sections and sent to various fortified places round the mouth of Portsmouth Harbour, including Haslar, Fort Monkton, Southsea Esplanade, Southsea Castle and Spit Bank Fort. At these places the sections were further divided into parties for running the oil engines and search-

lights, practice runs being held on both Monday and Tuesday mornings and evenings.

On Wednesday morning another practice was gone through till about 12 o'clock, but the remainder of the day was given up to recreation. In the afternoon the Electrical Engineers engaged in a cricket match with the Royal Engineers who played six officers. A very close game resulted in the defeat of the Electricians by three runs, the scores being 58 and 55.

Another party was shooting against the R.E., but this match had to be abandoned owing to a heavy rainstorm.

In the evening a successful impromptu smoking concert was held, which was attended by a considerable number of the Regulars quartered at the fort. On Thursday two more runs were gone through to thoroughly prepare the men for Friday night, when a number of vessels were to attempt to get into the harbour. Not much was done on Friday till the evening, with the exception of a general clean up of the engines and lamps.

For the night-run the men were taken over to their respective stations at 7.30, and had all the lights going at 9 o'clock.

—The first boats attempted to get through at about 11 o'clock, but were immediately detected and saluted with volleys from the nearest guns. The night was by no means favourable to the attacking party, as it was very fine and starlight, but it seems highly probable that any attempt to get into the harbour, save perhaps under cover of a thick fog, would meet with failure, so excellently are the lights arranged to cover the various channels by which approach is possible. Every vessel coming in was picked up by the first light, and passed on to the next, and so on, so that each was in view for perhaps a couple of miles. The run was finished at about 3 o'clock on Saturday morning, when daybreak rendered the searchlights of no further use. The men were then taken back to Fort Blockhouse, where they obtained a little rest.

The whole detachment was inspected at 9 o'clock, the men appearing very little fatigued by their night's work.

The South African medal was presented to Lieut. Colson and C.S.M. Graham by the inspecting officer, who addressed a few words of congratulation to the recipients.

The company left Gosport at 11.30, and arrived in town at 2.30, having completed a very satisfactory week's work.

The thanks of the detachment are due to Sergt.-Major Ruse, R.E., for the able way in which he conducted the arrangements necessary for the comfort of the men.

THE PROGRESS OF ELECTRIC SPACE TELEGRAPHY.*

By G. MARCONI.

(*Concluded from page* 88.)

I HAVE had occasion to notice that the signals audible in the telephone are weakest when the poles of the rotating magnet have just passed the core and are increasing their distance from it, whilst they are strongest when the magnet's poles are approaching the core.

Good results have also been obtained by keeping the magnet fixed, and using an endless iron rope or core of thin wires revolving on pulleys (worked by clockwork), which cause the iron to travel through the copper wire windings in proximity to preferably two horse-shoe magnets with their poles close to the windings, care being taken that their poles of the same sign are adjacent.

This detector has been successfully employed for some time in the reception of wireless telegraphic messages between St. Catherine's Point, Isle of Wight, and the North Haven, Poole, over a distance of 30 miles, also between Poldhu, in Cornwall, and Poole, in Dorset, over a distance of 152 miles, of which 109 are over sea and 43 over high land.

It would, no doubt, be possible to obtain signals by causing the iron core to act directly on a telephone diaphragm, and in this case the secondary winding could be omitted.

This detector, as I have already stated, appears to be more sensitive and reliable than a coherer, nor does it require any of the adjustments or precautions which are necessary for the good working of the latter. It possesses a uniform and constant resistance, and as it will work with a much lower E.M.F., the secondaries of the tuning transformers can be made to possess much less inductance, their period of oscillation being regulated by a condenser in circuit with them, which condenser may be much larger—in consequence of the smaller inductance of the circuit—than those used for the same period of oscillation in a coherer circuit, with the result that the receiving circuits can be tuned much more accurately to a particular radiator of fairly persistent electric waves.

As a call, a coherer in circuit with a relay working a bell can always be used, and if it is found possible to make the magnetic detector record on a registering instrument (as to the possibility of which the results of recent tests have left little doubt in my mind), it may be found possible to receive wireless telegraph messages at a speed of several hundred words a minute. At present, by means of this detector, it is possible to read about 30 words per minute.

The considerations which led me to the construction of the above-described detector are the following:—

It is a well-known fact that, after any change has taken place in the magnetic force acting on a piece of iron, some time elapses before the corresponding change in the magnetic state of the iron is complete. If the applied magnetic force be caused to effect a cyclic variation, the corresponding induced magnetic variation in the iron will lay behind the changes in the applied force. To this tendency to lag behind, Prof. Ewing has given the name of magnetic hysteresis.

It has been shown also by Profs. Geresa, Finzi and others, that the effect of alternating currents or high frequency electrical oscillations acting upon iron is to reduce considerably the effects of magnetic hysteresis causing the metal to respond readily to any influence which may tend to alter its magnetic condition.

The effect of electrical oscillations probably is to bring about a momentary release of the molecules of iron from the constraint in which they are ordinarily held, diminishing their retentiveness, and consequently decreasing the lag in the magnetic variation taking place in the iron.

I, therefore, anticipated that the group of electrical waves emitted by each spark of a Hertzian radiator would, if caused to act upon a piece of iron which is being subjected at the same time to a slowly varying magnetic force, produce sudden variations in its magnetic hysteresis, which would cause others of a sudden or jerky nature in its magnetic condition. In other words the magnetisation of the iron, instead of slowly following the variations of the magnetic force applied, gives a sort of jump each time it is affected by the electric waves emitted by each spark of the radiator.

These jerks in the magnetic condition of the iron would, I thought, cause induced currents in a coil of wire, of strength sufficient to allow the signals transmitted to be detected intelligibly on a telephone, or perhaps even read on a mirror galvanometer. The results obtained go to confirm my belief that this detector can be advantageously substituted for the coherer for the purposes of long distance space telegraphy.

During the last few years the developments in the practical applications of my system have been exceedingly rapid. Time does not allow me to give you an account of the many cases in which it has proved its usefulness, but it may be sufficient if I mention that Lloyds have adopted the system exclusively for use at their stations at home and abroad for a period of 14 years, and that no less than 17 liners plying across the Atlantic carry permanent installations. In more than one case recorded in the daily papers the system has been of service to vessels in distress, especially in the English Channel.

No less than 40 land stations (most of which are controlled by the Corporation of Lloyds) are being equipped with the system in Great Britain and Europe, and over 40 vessels in H.M. Navy carry installations.

The adoption of my system in the Royal Navy has brought about a certain slight change of appearance in the rig of the ships. Some naval officers believe that this change improves the ships' appearance; others think the contrary.

The Italian Admiralty, after experimenting for some time with the self-decohering coherers to which I have referred before, have informed me officially by a letter dated May 24th last, of its decision to equip their war vessels with the same apparatus as has been successfully employed on the trans-Atlantic liners.

On these liners commercial use is made of the system for the convenience of passengers, and as an illustration of its commercial workableness, I might mention that lately the *Campania* and *Lucania*, of the Cunard Line, have been collecting as much as £60 each trip in receipts derived from passengers' wireless messages.

Nearly two years ago the facility with which communication was possible over distances of nearly 200 miles, and the improvements introduced in syntonic methods, together with the ascertained fact of the non-interference of the curvature of the earth, led me to decide to recommend the construction of a large power station in Cornwall, and another at Cape Cod, Mass., U.S.A., in order to test whether, by the employment of much greater power, it might not be possible to transmit messages across the Atlantic, and establish a trans-oceanic commercial communication which the monopoly of the Postmaster-General will not apparently permit between two stations if both are situated in Great Britain.

An unfortunate accident to the masts at Cape Cod seemed likely to postpone the experiments for several months, when I came to the conclusion that whilst the necessary repairs there were being carried out, I would use a purely temporary installation in Newfoundland for the purpose of a trans-Atlantic experiment, from which I might at any rate be able to judge how far the arrangements in Cornwall had been conducted on right lines. Before

* Discourse delivered at the Royal Institution, London, on Friday, June 13th, for a copy of which we are indebted to Marconi's Wireless Telegraph Company, Limited.

describing the results, it may be useful if I give a brief description of the nature of the apparatus used at the transmitting and receiving stations.

The transmitter at Poldhu was similar in principle to the syntonic one I have already described, but the elevated conductor at the transmitting station was much larger, and the potential to which it was charged very much in excess of any that had previously been employed, the amount of energy to be used in this transmitting station having been approximately determined by me prior to its erection.

The transmitting elevated conductor consisted of 50 almost vertical naked copper wires suspended at the top by a horizontal wire stretched between two poles, each 48 metres high, and placed 60 metres apart. These wires were separated from each other by a space of about 1 metre at the top, and after converging together, were all connected to the transmitting instruments at the bottom. The potential to which these conductors were charged during transmission was sufficient to cause sparking between the top of the said wires and an earthed conductor across a space of 30 centimetres of air.

The general engineering arrangements of the electric power station erected at Poldhu for the execution of these plans, and for creating the electric waves of the frequency which I desired to use, were made by Dr. J. A. Fleming, F.R.S., who also devised many of the details of the appliances for producing and controlling the electric oscillations. These, together with devices introduced by me and my special system of syntonisation of inductive circuits, have provided an electric wave generating plant more powerful than any hitherto constructed. Mr. R. N. Vyvyan and Mr. W. S. Entwistle have also greatly assisted me in the experiments carried out with the very high tension electrical apparatus employed.

The first experiments were carried out in Newfoundland last December, and every assistance and encouragement was given me by the Newfoundland Government. As it was impossible at that time of the year to set up a permanent installation with poles, I carried out experiments with receivers joined to a vertical wire about 400 ft. long elevated by a kite. This gave a very great deal of trouble, as, in consequence of the variations of the wind, constant variations in the electrical capacity of the wire were caused. My assistants in Cornwall had received instructions to send a succession of "S's," followed by a short message at a certain prearranged speed, every ten minutes, alternating with five minutes' rest during certain hours every day.

Owing to the constant variations in the capacity of the aerial wire, it was soon found out that an ordinary syntonic receiver was not suitable, although a number of doubtful signals were at one time recorded. I therefore tried various microphonic self-restoring coherers placed in the secondary circuit of a transformer, the signals being read on a telephone. With several of these coherers signals were distinctly and accurately received, and only at the pre-arranged times, in many cases a succession of "S's" being heard distinctly, although, probably in consequence of the weakness of the signals and the unreliability of the detector, no actual message could be deciphered.

The coherers which gave the signals were:—One containing loose carbon filings; another, designed by myself, containing a mixture of carbon dust and cobalt filings; and, thirdly, the "Italian Navy Coherer," containing a globule of mercury between two plugs. For the good results obtained I was very much indebted to two of my assistants, Mr. G. S. Kemp and Mr. P. W. Paget, who gave me very efficient aid during the tests, which the extremely severe weather prevailing in December in Newfoundland made exceedingly difficult to carry out.

The result of these tests was sufficient to convince myself and my assistants that, with permanent stations at both sides of the Atlantic and by the employment of a little more power, messages could be sent across the ocean with the same facility as across much shorter distances.

The experiments could not be continued or extended in consequence of the action which the Cable Company which claims all telegraphic rights in Newfoundland saw fit to take at the time. Having received a most generous invitation from the Government of the Dominion of Canada to continue my operations in the Dominion, it was thought undesirable to continue the experiments in Newfoundland, where I should have probably been landed into litigation with the Telegraph Company.

■ I am glad to say that the Canadian Government, on the initiative of Sir Wilfred Laurier and Mr. Fielding, has shown itself most enterprising in the matter, and not only encouraged the erection of a large station in Nova Scotia, but actually granted a subsidy of £16,000 towards the erection of this trans-Atlantic station, the object of which is to communicate with England from the coast of Nova Scotia. It is anticipated that the Canadian station will be ready for further tests very shortly. Another station for the same purpose is being erected on the U.S. coast.

Towards the end of February of this year I thought it desirable to test how far the messages transmitted by the powerful station at Poldhu could be detected on board a ship. The ship selected was the *Philadelphia*, of the American line. The receiving aerial conductor was fixed to the mast, the top of which was about 60 metres above sea level.

As the elevated conductor was fixed, and not floating about with a kite, as in the case of the Newfoundland experiments, very good results were obtained on an ordinary syntonic receiver similar to those I have already described, and the signals were all recorded on tape by the ordinary Morse recorder.

■ Readable messages on tape were received up to a distance of 1,551 miles from Cornwall, and indications were received as far as 2,099 miles. Most of the messages were received in the presence of the captain or the chief officer of the ship, who were good enough to sign the tapes. I have some of these tapes here, in a frame, and they can be examined at the conclusion of my discourse.

It is curious to observe that signals could not be received at over 900 miles by any of the self-restoring coherers. The reason for this lies probably in the fact that the tuned receiver, when connected to a fixed aerial, is more efficient.

Another result of considerable scientific interest was that at distances of over 700 miles the signals transmitted during the day failed entirely, while those sent at night remained, as I have stated, quite strong up to 1,551 miles, and were even decipherable up to a distance of 2,099 miles.

This result, which I had the honour of describing before the Royal Society yesterday, may be due to the dissectrification of the very highly charged transmitting elevated conductor operated by the influence of daylight.

I regret time does not permit me to give you the views which have been expressed with reference to this phenomenon. I do not think, however, that the effect of daylight will be to confine the working of trans-Atlantic wireless telegraphy to the hours of darkness, as sufficient sending energy can be used during day time at the transmitting station to make up for the loss of range of the signals, and therefore this business of communicating across the Atlantic will not be one of those works of darkness with which some people connected with cable companies would seem disposed to class it. It is, however, probable, that had I known of this effect of light at the time of the Newfoundland experiments, and had tried receiving at night time, the results would have been much better than those that were obtained.

The day is rapidly approaching when ships will be able to be in touch and communication with the shore across all oceans, and the quiet and isolation from the outside world which it is still possible to enjoy on board ship will, I fear, soon be things of the past.

However great may be the importance of wireless telegraphy to ships and shipping, I believe it will be of even greater importance to the world if found workable and applicable over such great distances as those which divide Great Britain from her colonies and from America.

Any of those who have lived in the colonies will easily appreciate what a hardship it is to have to wait, perhaps, four or five weeks before receiving an answer to a letter sent home. The cable rates are at present prohibitive to a vast majority of people. May it not, perhaps, be for wireless telegraphy to supply the want?

I apologise for having kept you so long, but I cannot help reading you, in conclusion, a short extract from a leading article in the London *Times* of Saturday, December 21st, 1901, published, i.e., at the time of the Newfoundland experiments. And I do so because it expresses in language of admirable clearness the sentiments with which I myself regard this subject:—

"It would probably be difficult to exaggerate the good effect of wireless telegraphy if, as Mr. Marconi and Mr. Edison evidently believe, and as the Anglo-American Company evidently fear, it can at no distant time be developed into a commercial success.

"The expense of telegraphy to distant countries is at present prohibitory to vast numbers of people; and even those who use it do so only in respect of matters of great urgency, or in which large money interests are at stake.

"The reason of the high charges must be sought, of course, in the enormous costliness of the plant, both in its original construction and in its maintenance and repair. A system of aerial telegraphy which would not require an expensive plant, and through which, therefore, messages might be sent at moderate rates, would soon become a potent agent in cementing those ties between Great Britain and the Colonies which other recent events have done so much to strengthen and even to create. A system of comparatively cheap telegraphs would do for the British Empire very much what was done by the penny post for the United Kingdom.

"The pathetic story of Rowland Hill, whose efforts to establish cheap postage originated in the sympathy he felt for a poor girl in a Cumberland village, who was unable to pay the sum demanded for a letter from her brother in a distant county, relates an event which in principle may be repeated to-day in many parts of the world.

"A cheap telegraph service would unite families, however scattered, would keep the dispersed members in close and constant touch with the old home, and would cement friendships between our own people and the Colonial nations, besides forging another link in the ties which bind this country to the United States."

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1902.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 323, High Holborn, London W.C., and at Liverpool, to whom all inquiries should be addressed.

14,471. "Improved regulator for electric instruments." W. THOMSON (BARON KELVIN). June 29th.

14,479. "Improvements in shade or globe holders for incandescent electric lamps." A. A. GUEST. June 30th.

14,489. "Improvements in electrical recording instruments of the maximum demand meter type." T. HESKETH. June 30th.

14,507. "Improvements in controlling devices for electric motors." J. S. HIGHFIELD. June 30th.

14,523. "Improvements relating to electric ignition devices for motor cycles and other services." A. P. MAXFIELD and C. R. GARRARD. June 30th.

14,547. "Improvements in and relating to electrical measuring instruments." E. WESTON. June 30th. (Complete.)

14,572. "Improved lightning conductor for electrical installations." SIEMENS BROTHERS & CO., LTD. (Siemens & Halske Aktein Gesellschaft, Germany.) June 30th. (Complete.)

14,573. "Improvements in switches for electrical glow lamps." THE EDISON & SWAN UNITED ELECTRIC LIGHT COMPANY, LIMITED, J. SHEPHERD and H. D. GOVER. June 30th. (Complete.)

14,605. "Improvements in starting switches for electric lifts." EASTON AND COMPANY, LIMITED, P. IBOTSON UPWIN and J. BJORNSTAD. June 30th.

14,612. "Improvements in incandescent electric lighting." I. H. HEGNER. June 30th.

14,667. "Improvements in electricity meters." E. SCHATTNER. July 1st.

14,670. "An improved method of operating the points of electric tramways and the like." H. WALKER. July 1st.

14,676. "Improvements relating to electric railways." W. M. BROWN. July 1st. (Complete.)

14,716. "Improvements in automatic electric lock and block signalling." T. H. JONES. July 1st.

14,761. "Improved tumbler switch for electric lighting." J. D. F. ANDREWS and ELECTRICAL PRODUCTIONS, LIMITED. July 2nd.

14,767. "Improvements in or relating to electric lamps and switches therefor." E. R. GILL. July 2nd.

14,768. "Improvements in or relating to portable electric lights." E. R. GILL. July 2nd.

14,773. "Apparatus for controlling from a distance electro-motors serving to actuate ships' rudders, sluice gates, swing bridges and the like." SIEMENS BROS. & CO., LTD. (Siemens & Halske Aktien-Gesellschaft, Germany.) July 2nd. (Complete.)

14,774. "Electrical apparatus for working reciprocating tools." VICKERS, SONS & MAXIM, LTD., A. D. WILLIAMSON and C. L. SUMPTER. July 2nd.

14,775. "An improvement in the construction of laminated armatures and the like for ventilation therefor." VICKERS, SONS & MAXIM, LTD., and A. D. WILLIAMSON. July 2nd.

14,781. "Improvements in process and apparatus for subjecting gases to high tension electrical discharges." B. J. B. MILLS. (The Atmospheric Products Company, United States.) July 2nd. (Complete.)

14,788. "Improvements in automatic switches for telephones." E. W. SCHNEIDER. July 2nd. (Complete.)

14,790. "Improvements relating to armature windings for electric motors or dynamos." THE JOHNSON-LUNDELL ELECTRIC TRACTION COMPANY, LTD. (R. Lundell, United States.) July 2nd. (Complete.)

14,809. "An improved electrical high tension switch." T. HENWOOD. July 3rd.

14,822. "Improvements in detectors of electric currents induced in systems of space telegraphy." E. WILSON. July 3rd.

14,836. "Improvements in the field magnet cores of dynamo-electric apparatus." K. KISHI. July 3rd.

14,851. "Improvements in or relating to electric vehicles." L. LOHNER and F. PORSCHE. July 3rd.

14,869. "Improvements relating to electric arc lamps." H. H. LAKE. (H. Cuénod, Switzerland.) July 3rd.

14,878. "Improvements in the construction of electric lamps." J. H HEGNER. July 3rd.

14,884. "Improvements in electric distribution systems." H. H. LAKE (General Electric Company, United States.) July 4th.

14,887. "An electric battery." J. C. BOOTH. July 4th.

14,897. "An improvement in 'frogs' or points for overhead wire systems of electric traction." W. HARRIS, H. BRECKNELL, E. M. MUNRO and H. I. ROGERS. July 4th.

14,899. "Improvements in connection with the safety fuses for electric circuit." E. SCHATTNER. July 4th.

14,901. "Improvements in or connected with the brakes of electric and similar tramcars and vehicles." G. ATHERTON. July 4th.

14,947. "Improvements in or relating to electric systems." C. F. BAUDRY. (Date applied for under Patent Act, 1901, December 14th, 1901, being date of application in France.) July 4th. (Complete.)

14,971. "Improvements in automatic telephone exchange apparatus." M MARGOWSKI and C. GORICK. July 4th.

15,029. "Improvements in and relating to life-guards for tramcar and other electrically-propelled vehicles." W. SIMM. July 5th.

15,038. "Improvements in connection with electric arc lamps." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED, A. J. IRELAND and F. SAMUELSON. July 5th.

15,039. "Improvements in method and means for connecting multiphase electric circuits." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (W. S. Moody, United States.) July 5th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1900

8,234. "Improvements in electric rail bonds." C. F. de Radon. Dated May 3rd, 1900. Rail bonds are held in contact with the rails by spring pressure instead of being screwed or rivetted. The contact faces of the bond are pressed against the rail webs by a staple, and spring held by one of the fish-bolts. A soft metal plate surrounds and protects the contacts from moisture, &c. A similar bond and protector may be applied under the flange. 1 claim.

8,239. "An improvement in electricity meters constructed on the Ferraris principle." Siemens and Halske. Dated May 3rd, 1900. Relates to energy and quantity meters. An induction motor meter, having a conductor travelling between laminated iron cores, wound with coils conveying alternating currents in different phases, and with closed magnetic circuits, has one or two recesses formed in the inner cylindrical core, which may be adjusted by an arm engaging screws to place the recesses near opposite poles of the core. Frictional and other errors may thus be compensated for without affecting the fields of one pair of poles. The recesses may be rounded, as shown, or flat, or rectangular, or eccentric slots; or round holes may be made near the edge of the core. The coils on one pair of poles may carry the main or a proportional current; those on the poles may carry the same, or current due to a pressure factor. 1 claim.

8,241. "Improvements in electricity meters." M. Kallmann. Dated May 3rd, 1900. Current, energy, and quantity meters, testing—An apparatus is constructed for measuring the times which an electric current is supplied between particular limits of strength, but may be modified for other purposes. The current is passed through a solenoid acting on a core and a balanced beam, which may hold a roller against one of four sliding plates connected by levers to vertical rods, so as to depress the corresponding rod against spring pressure. Each rod carries a gear wheel which, when depressed, connects one of four wheels on a shaft driven by a clock, with one of four adjacent wheels, each of which is geared to a separate indicating pointer I., II., III., IV. These may respectively indicate the time during which the current strength is from 10 to 30, 30 to 50, 50 to 70, or over 70 per cent. of the maximum intended to be supplied. In modifications the core may be replaced by a pressure coil, so that the apparatus indicates power instead of currents. The core and solenoid may be replaced by electro-magnetic relays, or by a voltmeter or insulation indicator when the apparatus is used for pressure or insulation testing. The driving clock may be replaced by a meter motor, so that the dials indicate quantity or energy supplied at different rates. 4 claims.

8,289. "Improvements in or in connection with insulated electric cables or conductors and the manufacture thereof." G. E. Hoyl-Dia. Dated May 4th, 1900. Two or more insulated or bare conductors are covered with india-rubber or other similar material by passing the conductors and two strips of the insulating material between grooved rollers. The flanges of the grooves are arranged to unite, but not sever, the strips of insulating material except the outside edges. The insulated conductors may afterwards be separated as desired by knives and external coverings applied. Cutting edges on the rollers may also be arranged to divide the cables into twin or other multiple form during covering. 2 claims.

8,290. "Improvements in or relating to insulated electric cables or conductors and the manufacture thereof." G. E. Hoyl-Dia. Dated May 4th, 1900. Multiple conductors, such as described in Specification No. 8,289, A.D. 1900, are separated and recovered between rollers, a spacing piece being arranged between the conductors. The upper roller may have a ridge by which a depression is formed to facilitate the use of nails, &c., in securing the cable in position. 2 claims.

8,299. "Improvements relating to two liquid primary batteries and regenerating the same." H. J. Dercum. Dated May 4th, 1900. Relates to two fluid batteries, and consists in the use of a mixture of a depolarising agent and an exciting agent in both compartments of the battery, the exciting agent in the depolarising department being chemically inactive, while the depolarising agent in the compartment for the excitant is chemically inactive. When the battery is exhausted, the two liquids are mixed together and regenerated so as to serve again either as an excitant or a depolariser. The invention is described in its application to a battery with zinc anodes and with chromic acid as the depolariser, and dilute sulphuric acid as the excitant. 4 claims.

8,300. "Improvements relating to two liquid primary batteries and regenerating same." H. J. Dercum. Dated May 4th, 1900. Relates to two fluid batteries, and consists in the use of a liquid which is a mixture of a depolariser and excitant, and is first used as a depolarizer until the depolarising agent is reduced, and is then used as an excitant until the excitant is exhausted. The invention is described in its application to a battery with zinc anodes, and with chromic acid (or oxide), as the depolariser and dilutes sulphuric acid as the excitant. This liquid, after being used successfully as a depolarizer and excitant is regenerated in the same way, and by the same apparatus as are described in Specification No. 8,299, A.D. 1900. 7 claims.

8,315. "Improvements in electric switches." W. F. Jones. Dated May 5th, 1900. Switches for controlling motors, &c. The contact arm is operated through an electro-magnetic clutch, which is released in case of over or under load. Reference is made to Specification No. 6,819, A.D. 1899. 3 claims.

8,344. "Improved double plug and socket for electrical connections." F. H. Miss. Dated May 5th, 1900. Relates to improvements in double pin plugs and sockets. 6 claims.

8,347. "Improvements in or relating to the trolley head employed in connection with electrically propelled cars or vehicles." J. Taylor and A. Hudson Dated May 5th, 1900. Relates to electric railways and tramways with overhead conductors. The trolley wheel pivot is mounted in lugs on a plate which swivels on rollers mounted in the base of the head. Other rollers on the plate bear under the cap, which is hinged and is secured by a bolt carrying one of the first-mentioned rollers. A forked lug under the plate lies between springs on a curved guide attached to the base, so that the trolley is kept in line with the trolley wire. The head has a split socket clamped on the pole by a bolt, and the conductor passing down the pole is attached to the head by the connecting piece and bolt. The trolley wheel has a graphite bushing and a soft metal bearing for the wire secured by the hexagonal centre of the wheel, loose flange, and lock nut. 1 claim.

8,361. "Improvements in apparatus for switching electric current on and off, especially suitable for lighting telephone switchboards." F. Gill, R. Gilmour, and P. Clexton. Dated May 5th, 1900. Relates to the electric lighting of switchboards to the supply of current for calling purposes when the work is not continuous, and to like purposes. 4 claims.

8,388. "Improvements in automatic telegraphic receiving instruments for Morse characters." L. Cerebotani and C. Moradelli. Dated May 7th, 1900. Relates to arrangements for single, multiplex and internal tens transmission from both ends by means of apparatus similar to that described in Specifications No. 20,389, A.D. 1899, and No. 7,082, A.D. 1900. 5 claims.

8,433. "Process for the production of electrically conductive illuminating bodies." F. Dannest. Dated May 7th, 1900. Incandescent lamps. Homogeneous conductive illuminating bodies are made by moulding and heating a plastic paste of sucrate of lime, or other chemical compound yielding carbon and a metallic oxide in definite proportions when carbonised. A concentrated solution of an inorganic metallic salt may be added to decrease the proportion of carbon in the product. 2 claims.

8,434. "Improvements in the manufacture of electric incandescence bodies." F. Dannest. Dated May 7th, 1900. Incandescent lamps. Incandescence bodies are made of carbon with metallic oxides, in quantities gradually increasing towards the surface. By one method a filament, which may be previously carbonised, is boiled in different solutions of sugar and lime or metallic salts, with increasing proportions of metal, and baked in a muffle after treatment with each solution. 3 claims.

8,465. "Improvements in or relating to electric motors." A. J. Boult. Dated May 8th, 1900. Relates to electric motors with two armatures particularly adapted for use in propelling and steering motor road vehicles. A hollow field frame is provided with inwardly projecting poles at opposite sides, and a central removable partition forming part of the magnetic circuit, and also provided with a pair of poles. The armatures are mounted in bearings so as to rotate between the poles. They may be geared to two independent driving wheels of a motor road vehicle and provided with separate means for regulating their speed, so that, when turning corners they may be driven at different speeds. 4 claims.

8,471 "Improvements in electrical accumulators." L. Renaud. Dated May 8th, 1900. One of the electrodes, preferably the negative electrode, is made up of a lead trough containing active material and serving also as the battery cell. In the active are placed at intervals perforated tubes of lead or of non-conducting material. Other openings not shown are also made in the active material to facilitate the circulation of the electrolyte and the escape of gases. The positive electrodes, which are provided with insulating feet, are placed in the tubes. The positive electrode may be a perforated tube filled with active material in which may be inserted a wire, or a screw, or it may be made up of lead discs threaded on a wire or rod. 2 claims.

8,476. "Improvements in induction electric motors." H. M. Hobart. Dated May 8th, 1900. Motors, alternating current. For purpose of giving an induction motor a suitable starting torque, the property of conductors known as "skin effect" is utilised, the secondary winding of the motor being connected to resistances which are preferably made of wrought-iron. A three-phase secondary winding connected through slip rings and brushes with a set of three wrought-iron resistances is described. Resistances of the kind specified may be applied in other ways, or the conductors of the winding themselves may be so proportioned as to produce the same effect. 1 claim.

8,668. "Improvements in electric arc lamps." J. Meizer. (Interstate Electric Company.) Dated May 10th, 1900. Relates to electric arc lamps and is too long for the purposes of abridgment. 24 claims.

8,671. "Improved construction of electric switch." E. Schutz. Dated May 10th, 1900. Switches for lamps, holders, &c. The insulating base or block is made in two parts, recessed to receive the switch mechanism. This consists of a square spindle of insulating material fitted with a metal contact stud, and a suitable handle or key. In the one recess is fitted the connecting piece for one lead and in the other, spring contact with which the stud engages. The leads are secured in their terminals by screws. One of the half blocks is formed with an extension. 3 claims.